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NINTH ANNUAL REPORT

OF THE

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Elder, Mrs. Matilda A.,
Eldridge, Frederick L.,
Eldridge, Lewis A.,
Eldridge, Roswell,
Eldridge, William T.,
Ellis, William H.,
Ellsworth, Duncan S.,
Ellsworth, John Magee,
Ellsworth, Lincoln,
Emanuel, J. H., Jr.,
Emery, John J.,
Emigh, Mott,
Emmet, C. Temple,
Emmet, Miss Lydia F.,
Emmet, Robert Temple,
Endicott, Robert,
English, E. M.,
Ennis, Dr. James Seferen,
Eno, John Chester,
Epstean, Edward,
Erbsloh, R.,
Eschmann, F. W. R.,
Ettlinger, Louis,

* Deceased

Eustis, John E.,
Evans, Mrs. Cadwalader,
Evans, Richard,
Evarts, A. W.,
Evarts, Sherman,
Faas, John,
Fabbri, Alessandro,
Fabbri, Ernesto G.,
Fabbri, Mrs. Ernesto G.,
Fahnestock, Harris C.,
Fahnestock, William,
Fairbanks, Henry P.,
Fairchild, David,
Fairchild, H. S.,
Fairchild, Nelson,
Falk, Gustav,
Falvey, Frank A.,
Fargo, James C.,
Farnham, Paulding,
Farrar, Nathaniel B.,
Farrington, Harvey,
Fearing, George R.,
Fearon, J. S.,
Fernstrom, H.,
Field, William B. Osgood,
Fischer, William H.,
Fisher, L. G.,
Fisk, Harvey Edward,
*Fiske, J. W.,
Fitch, Ezra H.,
Fitzgerald, Gen. Louis,
Flower, Anson R.,
Foot, James D.,
Forbach, Charles,
Forrester, George B.,
Foster, Edward W.,
Foster, Giraud,
Foster, Macombe G.,
Foster, Scott
Fowler, Otis L. R.,
Fraser, Alex V.,
Fraser, Mrs. George S.,
Fraser, William C.,
Fried, Samson,
Frissell, A. S.,
Fulda, Dr. Carl,
Fulda, Dr. Clemens,
Fuller, Charles D.,
Fuller, Mrs. Eugene,
Fuller, Henry D.,
Fulton, John, Jr.,
Funke, Edmund A.,
Ganz, Anthony,
Garrett, John W.,
Gautier, Dudley G.,
Gay, Joseph E.,
Geer, Mrs. Walter,
Gerard, Mrs. James W.,
Gerli, Emanuel,
Gerrish, John Brown,
Gerster, Dr. Arpad G.,
Ghee, John F.,
Ghee, Thomas,
Gibney, Dr. Virgil P.,
Gilbert, Clinton,
Gillette, Dr. Curtenius,
Gilsey, Henry, Jr.,
Glazier, Henry S.,
Gleason, Michael,
Goddard, F. N.,
Godfrey, Mrs. E. D.,
Godwin, Harold,
Goldschmidt, S. A.,
Good, Martin Q.,
Goodhue, Charles E.,
Goodhue, Mrs. S. C.,
Goodwin, Rev. Francis,
Gotthelf, Charles,
Gotthelf, Herman,
Gotthold, Frederic,
Gould, Charles A.,
Gould, Charles W.,
Gould, Edwin,
Gould, George H.,
Goulden, Joseph A.,
Granbery, W. H.,
Grant, R. S.,
Graves, William L.,
Greeff, Ernest F.,
Greene, Gen. Francis V.
Greenough, John,
Greenwood, Isaac J.,
Greer, Charles,
Grinnell, George Bird,
Griscom, Clement A., Jr.,
Griswold, Chester,
Gross, Frank,
Gudewill, Rev. Rudolph H. E.,
Guggenheim, Simon,
Gulliver, William C.,
Gurnee, Walter S.,
Gwynne, John A.,
Haas, Otto,
Hadden, Dr. Alexander,
Hague, James D.,
Haight, Charles S.,
Haines, Henry F.,
Hallock, Charles P.,
Halls, William, Jr.,
Halstead, Miss L. P.,
Hamilton, Miss Elizabeth Stewart,
Hamilton, William Pierson,
Hammersley, Louis Gordon,
Hammond, James B.,
Hammond, Mrs. John Henry,
Hanan, John H.,
Hanson, Prof. Harry D.,

*Deceased.

Harbeck, Charles T.,
Hard, Anson W.,
Hardenbergh, T. E.,
Harper, Lathrop C.,
Hartog, Ferdinand J., Jr.,
Harvey, Eli,
Hasbrouck, Harold,
Haskell, George M.,
Hasslacher, Jacob,
Hastings, Mrs. Thomas,
Hatfield, Thomas F.,
Havemeyer, F. C.
Havemeyer, H. O., Jr.,
Havemeyer, T. A.,
Haven, George G., Jr.,
Havens, Albert G.,
Hawe, Matthew,
Hawley, E.,
Hawthorne, Miss Gwendolen,
Haynes, William De Forest,
Heckscher, John Gerard,
Heiman, Abraham,
Heiman, E.,
Heiman, Mrs. Sophie,
Heins, George L.,
Heinsheimer, L. A.,
Heintz, John C.,
Heitemeyer, Clemens,
Held, Dr. R. Johnson,
Hencken, Hancke,
Henkel, John,
Henriques, Dr. H. A.,
Hermann, Ferdinand,
Herrman, Mrs. Esther,
Herter, Dr. Christian A.,
Herzog, Lewis,
Hess, Selmar,
Hewitt, Mrs. Abram S.,
Hewitt, Herbert H.,
Hill, E. B.,
Hill, Henry,
Hilyard, George D.,
Hinchman, Walter,
Hinton, Dr. John H.,
Hiss, Philip,
Hitchcock, Center,
Hocart, J. H.,
Hodenpyl, Anton G.,
Hoe, Richard M.,
Hoe, Mrs. Richard M.
Hoe, Mrs. Robert,
Hoffman, Mrs. E. A.,
Holbrook, Mrs. F. S.,
Holbrook, Miss Lilian,
Holden, Edwin B.,
Holden, George A.,
Holland, Hedley L.,
Hollins, Henry B.,
Holt, Henry,
Homans, Mrs. Edward C.,
Homer, Wallace,
Hooley, Edwin S.,
Hoppin, Hamilton, L.,
Hoppin, Samuel Howland,
Hoppin, William W., Jr.,
Hoskier, H. C.,
*Howland, G. G.
Howland, Henry E.,
*Hoyt, Alfred M.
Hoyt, Colgate,
Hoyt, George S.,
Hoyt, Goold,
Hoyt, Mrs. Jesse,
Hughes, Charles E.,
Humphreys, Mrs. Edward Walsh,
Huntington, Rev. W. R.,
Hupfel, J. Christopher G.,
Hussey, William H.,
Husted, Seymour L., Jr.,
Hutchins, Augustus Schell,
Hutter, Karl,
Huyler, John C.,
Hyde, B. T. Babbitt,
Hyde, Clarence M.,
Hyde, Dr. Frederick E.,
Inches, George B.,
Inness, George, Jr.,
Inslee, Mrs. Helen C.,
Iselin, Adrian, Jr.,
Iselin, Columbus O'Donnell,
Iselin, John H.,
Isham, Charles H.,
Isham, Miss Julia,
Isham, Samuel,
Ivory, L. C.,
Jackson, Frederic Wendell,
Jackson, Dr. George Thomas,
Jackson, R. G.,
Jackson, Samuel Macauley,
Jackson, Theodore F.,
Jacob, Charles,
Jacob, Lawrence,
Jacobi, Dr. A.,
Jacobus, John S.,
Jacquelin, Herbert T. B.,
Jacquelin, John H.,
James, Arthur Curtiss,
James, Dr. Robert C.,
James, Dr. Walter B.,
Janeway, Dr. Edward G.,
Jeidell, Hugh,
Jenkins, William B.,
Jennings, Frederick B.,
Jennings, Philander R.,
Jennings, Walter,
Jester, Claude W.,
Jesup, Charles M.,
Jewett, C. H., Jr.,

Deceased.

Jewett, George W.,
Johnson, David S.,
Johnson, Mrs. F. Coit,
Johnston, William J.,
Joline, Adrian Hoffman,
Jones, H. Bolton,
Jones, Mrs. John D.,
Jones, Lewis Q.,
Judson, H. J.,
Kahn, Louis,
Kahn, Otto H.,
Kallman, Charles,
Kane, John Innes,
Kane, S. Nicholson,
Karatsonyi, Martin,
Kearney, Charles R.,
Keech, Frank B.,
Keil, Will M.,
Keith, D. E.,
Kelley, Austin P.,
Kellogg, Mrs. Charles,
Kelly, Eugene,
Kemp, Arthur T.,
Kent, Edwin C.,
Kenyon, Robert N.,
Keuffel, Wilhelm,
Kidder, James Hathaway,
Kimball, Alfred R.,
King, Edward,
King, Mrs. LeRoy,
King, Rupert Cochrane,
King, William F.,
*King, William W.,
Kip, Ira A., Jr.,
Kitching, Frank W.,
Klee, Benjamin,
Knapp, Dr. Herman,
Knapp, John M.,
Knoedler, Roland F.,
Kobbé, Lieut. Ferdinand W.,
Kohlman, Charles,
Kraus, Daniel,
Kretz, Howard C.,
Kuhn, George J.,
Kuhne, Percival,
Kunhardt, Henry R.,
Kuttroff, Adolf,
Lacombe, Hon. E. Henry,
La Farge, Oliver H. P.,
Lagai, Dr. George,
Lambert, Dr. Alexander,
Lambert, Dr. Samuel W.,
Landon, Francis G.,
Lane, Edward V. Z.,
Lane, James Warren,
Lange, J. D.,
Langeloth, J.,
Langmann, Dr. Gustav,
Lapsley, David,
Lathrop, Francis,
Latting, Charles P.,
Laudauer, I. N.,
Lawrence, Cyrus J.,
Lawrence, John Burling,
Lawrence, Newbold T.,
Lawrence, Townsend,
Lawrence, Walter Bowen,
Lawrence, W. V.,
Layng, J. D.,
Ledoux, Albert R.,
Lee, Mrs. Frederic S.,
Lee, Prof. Frederic S.,
Lee, J. Bowers,
Lefferts, Marshall C.,
Le Gendre, William C.,
Leitner, Jacob,
Leitner, Joseph,
Le Roy, Alfred,
Lesher, A. L.,
Letkemann, H. V.,
Levy, Emanuel,
Lewis, Frederic Elliott,
Lewis, Miss Marguerite,
Lewis, Percy Pyne,
Lewis, Dr. William J.,
Lewisohn, Adolph,
Libbey, O. B.,
Liebenau, Albert,
Liebertz, Joseph,
Lippmann, Daniel J.,
Litchfield, Edward H.,
Littauer, William,
Livermore, John R.,
Livingston, Thomas G.,
Livingston, William S.,
Lobenstine, William Christian,
Locker, Carl,
Loeber, Charles,
Logan, Walter S.,
Longenecker, Charles,
Longfellow, Mrs. Frederick W.,
Loring, J. Alden,
Low, Mrs. W. W.
Lowell, Miss Carlotta Russell,
Lowell, Mrs. Charles Russell,
Lucksinger, Jacques,
Lud, Dudley Olcott,
Ludewig, Charles H.,
Lueder, A.,
Lund, Mrs. F. A.,
Lusk, Prof. Graham,
Luttgen, Walther,
Lyman, Frank,
Lynde, Francis E. P.,
McAlan, John,
McAlpin, Mrs. Charles W.,
McAlpin, George L.,
McCall, John A.,

* Deceased.

McClure, S. S.,
McCurdy, Richard A.,
McFarland, Dr. W. Landram,
*McKay, Thomas.
McKim, Rev. Haslett,
McKim, John A.,
McKinney, Glenn Ford,
McLean, James,
McLean, Marshall,
McVickar, Edward,
Mace Arthur J.,
Maclay, Mrs. Robert,
Macy, George A.,
Magee, John,
Mager, F. Robert,
Maher, James S.,
Mahl, William,
Mairs, George H.,
Mali, Pierre,
Mann, William d'Alton,
Mapes, Daniel, Jr.,
Mapes, Ernest S.,
Markoe, Dr. J. W.,
Marling, Alfred E.,
Marlor, Henry S.,
Marsh, C. P.,
Marshall, Charles H.,
Marston, Edwin S.,
*Martin, F. E.
Martin, William R. H.,
Martinez Migual R.,
Maslen, Richard R.,
Mathews, Thomas,
Matthews, John H.,
Matthiessen, Marie,
Maxwell, Robert,
Mehl, Henry,
Mellen, Charles S.,
Merkel, Hermann W.,
Meyer, N. Hermann,
Meyer, Thomas C.,
Meyrowitz, Emil B.,
Middlebrook, Frederick,
Milbank, Albert J.,
Miles, John,
Miller, Mrs. Charles E.,
Miller, Edward F.,
Miller, Frank C.,
Miller, Roswell,
*Miller, William R.
Milliken, S. M.,
Mills, Abraham G.,
Mills, D. O.,
Minott, W. A.,
Mitchell, F. Kendall,
Mitchell, H. Raymond,
Moench, Hugo,
Moffat, George Barclay,
Montant, Alphonse,
Montgomery, Richard M.,
Moore, Casimir de R.,
Moore, Charles Arthur, Jr.,
Moore, Miss Faith,
Moore, Francis C.,
Moore, Dr. John W.
Moore, Miss K. T.,
Moore, Mrs. W. D.,
Morgan, Miss Annie T.,
Morgan, Miss C. L.,
Morgan, Edwin D.,
Morgan, George E.,
Morgan, George H.,
Morgan, J. P., Jr.,
Morgan, Junius S.,
Morgan, Mrs. Junius S.,
Morgan, Dr. Thomas H.,
Morrell, Mrs. Robert Lee,
Morris, Dave H.,
Morris, Fordham,
Morris, John Jacob,
Morris, Dr. Lewis R.,
Morse, Charles H.,
Mortimer, Richard,
Morton, A. L.,
Mott, Henry C.,
Mott, John Bowen,
Mott, Jordan L., Jr.,
Mueller, Charles F.,
*Munn, Henry Norcross.
Munroe, Henry W.,
Munson, Dr. A. E.,
Murgatroyd, John,
Murray, A. S.,
Neilson, Dr. Howard S.,
Nelson, James W.,
Nesmith, James,
Neumer, Ferdinand,
Nichols, Acosta,
Nichols, George L.,
Nichols, John W. T.,
Niles, Robert L.,
Noble, Alfred,
Noble, H. G. S.,
Norrie, A. Lanfear,
Notman, John,
*Nott, Dr. Frederick J.,
Noyes, Mrs. Henry D.,
Oakley, H. Cru'ger,
O'Connell, Michael,
Ogden, Charles W.,
Ogden, M. C.,
Olsen, Charles P.,
Olyphant, Robert,
Olyphant, Robert M.,
Onativia, John Victor,
O'Rourke, John F.,
Osborn, Mrs. Henry Fairfield,
Ostrander, Miss Mary M.

* Deceased.

Otten, Mrs. Gertrude,
Outerbridge, Dr. Paul,
Ovens, James,
Overton, Dr. Frank,
Painter, Dr. H. McM.,
Palmer, Francis F.,
Palmer, Nicholas F.,
Palmer, S. S.,
Pancoast, Richard,
*Parker, Francis Eyre,
Parsons, Edwin,
Parsons, Mrs. Edwin,
Parsons, H. de B.,
Parsons, John E.,
Parsons, William Barclay,
Parsons, William Barclay, Jr.,
*Parsons, William H.
Paterson, R. W.,
Paul, John J.,
Paul, W. A. O.,
*Pell, Mrs. Alfred,
Pell, Miss Frances,
Pell, Stephen H. P.,
Pelton, Franklin D.,
Pendleton, Francis Key,
Penfold, William Hall,
Penniman, George H.,
Perkins, Robert P.,
Perry, Charles J.,
Peters, Charles G.,
Peters, Samuel T.,
Peters, William Richmond,
Pfizer, Charles, Jr.,
Pickhardt, Carl,
Piel, Gottfried,
Piel, Michael,
Pierce, Henry Clay,
Pierson, Gen. J. Fred,
Pinchot, Gifford,
Platt, Frank H.,
Plympton, Gilbert M.,
Poggenburg, H. F.,
Poland, Dr. Samuel,
Pollock, George E.,
Porter, Clarence,
Porter, William L.,
Post, Abram S.,
Post, Edward C.,
Post, George B., Jr.,
Postley, Clarence A.,
Potter, Miss Blanche,
Potter, Edward Clarkson,
Potter, Frederick,
Potter, Miss Martha,
Potts, William Brevoort,
Pratt, George D.,
Prentice, John Hill,
Prentiss, George Lewis,
Prime, Miss Cornelia,
Prince, Edward S.,
Prince, Prof. J. Dyneley,
Pryer, Charles,
Putnam, R. M. S.,
Putnam, William A.,
Pyle, James Tolman,
Pyne, M. Taylor,
Pyne, Mrs. M. Taylor,
Quintard, Dr. Edward,
Rand, George C.,
Randolph, Edmund D.,
Randolph, L. V. F.,
Randolph, William W.,
Ranft, Richard,
Rapallo, Edward S.,
Rathborne, Richard C.,
Rauch, William,
Read, William A.,
Redmond, Goold H.,
Redmond, Henry S.,
Reese, T. T.
Reimer, Otto E.,
Reincke, E. A.,
Reinhardt, George N.,
Reynolds, E. B.,
Reynolds, James Bronson,
Rheinelander, Charles E.,
Rhinelander, Miss Serena,
Rhoades, John Harsen,
Richard, Auguste,
Richard, Edwin A.,
Richards, E. O.,
Riker, John L.,
Riker, Samuel,
Ripley, H. Dillon,
Ripley, Julian A.
Ripley, Louis A.,
*Ripley, Sidney Dillon
Rives, George L.,
Robbins, Chandler,
Robertson, Mrs. F. P.,
Robertson, R. H.,
Robins, Thomas,
Robinson, Eli K.,
Robinson, G. H.,
Robinson, G. N.,
Robinson, Henry A.,
Robison, William
Rockwood, William H.,
Roe, Frank O.,
Roe, Irving L.,
Roelker, Alfred,
Roesler, August,
Rogers, E. L.,
Rogers, James H.,
Rokenbaugh, Henry S.,
Roosevelt, W. Emlen,
Root, Elihu,
Ropes, Albert G.,

* Deceased.

Rose, John J.,
Ross, P. Sanford,
Rossiter, E. V. W.,
Roth, F. G. R.,
Rothwell, James E.,
Rowell, George P.,
Rungius, Carl,
Runyon, Carman R.,
*Runyon, Charles.
Ruppert, Jacob,
Ruppert, Mrs. Jacob,
Russ, William V.,
Ryan, J. D.,
Ryle, Arthur,
St. John, F. L.,
Sackett, Clarence,
Sackett, Miss Gertrude T.,
Sackett, Mrs. S. E.,
Sage, Dean,
Sage, John H.,
Sage, Mrs. Russell,
Sampson, Alden,
Sampson, Charles E.,
Sauter, Frederick,
Schaefer, Henry,
Schanck, George E.,
Schang, Frederick,
Schaue, C. F.,
Schefer, Carl,
Schieffelin, Mrs. H. M.,
Schieffelin, William J.,
Schilling, Robert H.,
Schirmer, Gustav,
Schirmer, Rudolph E.,
Schmitt, William P.,
Schneider, G. E.,
Scholl, Julian,
Scholle, A. H.,
Schultze, John S.,
*Schumacher, C.,
Schuyler, Miss Louis Lee,
*Schwab, Mrs. Gustav,
Schwarz, Henry F.,
Schweizer, J.,
Scott, Hon. Francis M.,
Scott, William,
Sears, Robert B.,
Sedgwick, Robert,
See, A. B.,
Seib, Henry,
Seligman, Alfred L.,
Seligman, Jefferson,
Seton, Alfred, Jr.,
Sexton, Lawrence E.,
Shapiro, D.,
Shaw, Charles Herbert,
Shaw, James G.,
Shaw, Walter W.,
Sheffield, James R.,
Sheldon, George R.,
Sheldon, William C.,
Sherman, Gardiner,
Shipway, John H.,
Shrady, Henry M.,
Shurtleff, Roswell Morse,
Siegel, Jacob,
Silleck, Henry G., Jr.,
Silleck, Mrs. Henry G., Jr.,
Silliman, Harper,
Simmons, Joseph F.,
Simons, James D.,
Simpson, John W.,
Simpson, William,
Skeel, Frank D.,
Skidmore, William L.,
Slade, Francis Louis,
Smiley, Daniel,
Smillie, Charles F
Smith, Augustine J
Smith, F. M.,
Smith, J. Henry,
Smith, Lucius H.,
Smith, Nathaniel S.,
Smith, Philip S.,
Smith, Robert W.,
Smith, William Alexander,
Smithers, Charles,
Smithers, F. S.,
Smyth, Philip A.,
Snow, C. G.,
Soltmann, E. G.,
Somerville, Charles Stuart,
Southack, Frederick,
Spedden, Frederic O.,
Speir, Mrs. Cecilia M.,
Spencer, Samuel,
Spiegelberg, F.,
Spitzner, George W.,
Spofford, Mrs. J. L.,
Spring, Miss Anna Riker,
Springmeyer, Albert A.,
Spurr, E. W.,
Squibb, Charles F.,
Squibb, Dr. Edward H.,
Stafford, William Frederick,
Stanton, John,
Stanton, John R.,
Starr, Louis Morris,
Stebbins, James H.,
Steers, Henry,
Steeves, John F.,
Steinbeck, Edward,
Stephens, Olin J.,
Stern, Isaac,
Stern, Vesty J.,
Sternbach, Charles,
Stevens, Alexander H.,
Stevens, Frederic W.,

* Deceased.

Stewart, William R.,
Stillman, James A.,
Stillman, T. E.,
Stimson, Dr. Daniel M.,
Stokes, H. B.,
Stokes, J. G. Phelps,
Stokes, Miss Olivia E. Phelps,
Stone, Mason A.,
Stone, Walter King
Stout, Andrew V.,
Stout, Joseph S.,
Stow, George G.,
Strange, A. B.,
Stratford, Prof. William,
Streat, James,
Streeter, D. D., Jr.,
Stuart, Inglis,
Sturges, Henry C.,
Stuyvesant, Rutherfurd,
Sullivan, Mrs. James,
Susser, John M.,
Sutphen, John S., Jr.,
Suydam, Harry L.,
Swayne, Francis B.,
Swenson, S. A.,
Syms, Dr. Parker,
Taber, Miss Mary,
Taft, Henry W.,
Talcott, James,
Tatham, Charles,
Tatum, A. H.,
Taylor, Dwight W.,
Taylor, George,
Taylor, Henry R.,
Taylor, Herbert C.,
Taylor, James B.,
Taylor, Knox,
Taylor, Lloyd,
Taylor, Moses,
Tenney, C. H.,
Terry, John T.,
Terry, Rev. Roderick,
Tesla, Nikola,
Thacher, Mrs. George W.,
Thacher, Thomas,
Thayer, Harry Bates,
Thomas, Dr. Allen M.,
Thomas, Seth E.,
Thomson, David,
Thorndike, Dr. Townsend W.,
Thorne, Jonathan,
Thorne, Newberry D.,
Thorne, W. V. S.,
Tibbits, Le Grand C.,
Tiffany, Louis C.,
Tilford, Henry M.,
Tilt, Mrs. A. V.,
Tilt, Benjamin B.,
Tilton, Joseph W.,
Timmermann, Henry G.,
Tod, J. Kennedy,
Todd, H. H.,
Tousey, William,
Townsend, Edwin S.,
Townsend, Isaac,
Townsend, J. Henry,
Townshend, John,
Tows, Coe Downing,
Traber, A. P.,
Trask, Spencer,
Trotter, William,
*Trowbridge, Edwin D.,
Trowbridge, Frederick K.,
Truax, Hon. Charles H.,
Tuckerman, Alfred,
Tuckermann, Paul,
Turnure, Arthur,
Turnure, Geo. E.,
Tweddell, William H.,
Underhill, G. H.,
Underwood, William Lyman,
Upmann, Carl,
Valentine, Dr. William A.,
Van Brunt, Hon. C. H.,
Van Cortlandt, Augustus,
Vanderbilt, Alfred G.,
Vanderpoel, Mrs. John A.,
Van der Smissen, Gilbert,
Van der Smissen, Dr. G. J.,
Van Emburgh, D. B.,
Van Nest, Mrs. Alexander T.,
Van Nest, G. Willett,
Van Norden, Warner,
Van Pelt, Gilbert S.,
Van Winkle, Edgar B.,
Varnum, James M.,
Verdi, Miss Mary,
Viele, Herman K.,
Vivanti, Ferruccio Anselmo
Vogel, Herman,
Vogel, John,
Vorce, A. D.,
Waddington, George,
Wadsworth, Clarence S.
Wadsworth, W. P.,
Wagner, Otto,
Wagstaff, C. Du Bois,
Walker, George L.,
Walker, George W.,
Waller, Robert, Jr.,
Walsh, Samuel A.,
Walter, Henry,
Walton, William,
Wanninger, Charles,
Warburg, Paul M.,
Ward, Artemas,
Ward, Henry C.,
Ward, J. Q. A.,

* Deceased.

Wardner, Henry Steele,
Wardwell, William T.,
Warren, John Hobart,
Waterbury, John I.,
Watson, Charles F.,
Watson, Rev. J. Henry,
Weatherbee, Edwin H.,
Webb, G. Creighton,
Webb, Dr. W. Seward,
Weber, Louis,
Welling, R. W. G.,
Wells, Oliver J.,
Wendell, Evert Jansen,
Wendell, Mrs. Jacob,
Wertheim, H. P.,
Westover, M. F.,
Wheelock, Dr. George G.,
Whitaker, H. P.,
White, Alain C.,
White, Horace,
White, John Jay, Jr.,
White, Leonard D.,
White, Stanford,
White, S. V.,
White, William W.,
Whitehouse, J. Henry,
Whitehouse, William F.,
Whiting, Dr. Charles A.,
Whiting, Miss Gertrude,
Whiting, Giles,
Whitman, Clarence,
Whitney, Caspar,
Whitney, Miss E. C.,
Whitridge, F. W.,
Wickersham, George W.,
Wiener, Felix F.,
Wiggin, Frederick Holme,
Willard, E. A.,
Willets, John T.,
*Willets, Robert R.
Williams, Richard H., Jr.,
Wills, Charles T.,
Wilmerding, Gustav L.,
Wilmsen, William,
Wilson, Dr. Edmund B.,
Wilson, George T.,
Wilson, Henry R.,
Wilson, William,
Wiltsee, Ernest A.,
Winant, Frederick,
Winckelbach, L. O.,
Winthrop, Egerton L.,
Winthrop, Egerton L., Jr.,
Winthrop, Robert Dudley,
Wisner, Charles,
Witherbee, Frank S.,
Witte, C. W.,
Witthaus, Dr. Rudolph A.,
Wolff, Emil,
Wood, Gilbert Congdon,
Wood, J. Walter, Jr.,
Wood, William Congdon,
Wood, William H. S.,
Woodcock, Edwin,
Woodcock, R. C.,
Woodhouse, J. S.,
Woodward, James T.,
Wright, J. Dunbar,
Wright, Mrs. J. Hood,
Wright, John Howard,
Wright, Mrs. Mabel Osgood
Wyckoff, Rev. Charles S.,
Youmans, Ephraim M.,
Young, A. Murray,
Young, Frederick Stafford,
Young, George W.,
Young, John Alvin,
Young, John W.,
Young, Richard N.,
Zabriskie, Andrew C.

Corresponding Members.

Barbour, Mrs. S. E.,
Brown, Herbert,
Brown, William Harvey,
Cornish, C. J.,
Elrod, M. J.,
Golding, Capt. Thos.,
Griffith, William A.,
Stone, Andrew J.,
Wilson, T. E.

Summary of Membership.

Benefactors	1
Total number of Founders	24
" " Associate Founders	12
" " Patrons	44
" " Life Members	182
" " Annual Members	1,315
Total of all classes, May 1, 1905	1,578

Qualifications for Regular Membership.

Annual Members	$ 10	Associate Founders	$ 2,500
Life Members	200	Founders	5,000
Patrons	1,000	Benefactors	25,000

Form of Bequest.

I do hereby give and bequeath to the "NEW YORK ZOOLOGICAL SOCIETY," *of the City of New York,*...

.....

.....

TLINKIT INDIAN TOTEM POLE AND HOUSE, FROM CAPE FOX, ALASKA.

Gift of E. H. Harriman.

REPORT OF THE EXECUTIVE COMMITTEE

DURING the year 1904 constant progress has been made in the development of the New York Zoological Park and the Aquarium. Several new buildings have been opened to the public and many animals of interest and value have been placed on exhibition, but the almost continuous work of construction that has been in progress during the year has forced the Committee to postpone some additions to its collections.

The attendance has remained satisfactory, and will be largely increased during the coming year by reason of the completion of the Rapid Transit system, which now terminates at West Farms. It is interesting to note in this connection that the maximum attendance at the Park for one day was on May 2d, 1904, when the visitors to the Park numbered 39,132.

NEW BUILDINGS AND INSTALLATIONS.

The new Bird House for small birds, located on the northwest corner of Baird Court, is nearing completion, and will be thrown open to the public early this spring. The south half of Baird Court has been completed, with the exception of the boundary walls. Much care and attention has been given by your Committee to the study of this feature of the Park, and to its approach from the north, known as the Concourse. A satisfactory design has at last been obtained, which will in every way be in accordance with the handsome buildings on Baird Court, and work will be commenced on the Court and Concourse as soon as the weather permits in the spring.

The Ostrich and Small Mammal Houses were finished and opened to the public in December, 1904, with their collections installed. The building for Asiatic deer has been completed, with eight connecting enclosures, containing a series of European and Asiatic deer, and on the west side of the Small Mammal Pond work has been commenced on an Aviary for Pheasants.

The Harriman Totem Pole and Alaskan House front have been erected on the Small Mammal Pond, opposite the Pheasants' Aviary, and now form a feature of much interest to visitors. Much time and money has been spent during the year on the renewal of the cheaply built walks and paths constructed by the City in 1899. In addition to this, many new paths have been provided for the constantly increasing attendance and to afford access to new installations.

WEST FARMS ENTRANCE.

At the end of the year 1904 a report was submitted by the chief engineer of the Rapid Transit system, recommending the extension of the Rapid Transit system by viaduct and open cut through the Buffalo Range and forests and rocks east of the Beaver Pond, crossing the Bronx River between the waterfall and Boston Road Bridge. This, of course, would have ruined this section of the Park, and the Society made every preparation to oppose the scheme. Before this became necessary the Rapid Transit Commission announced that no railroad would be constructed through a public park.

The road over the proposed route, with its noise and dirt of several hundred trains a day, would have destroyed the seclusion and beauty of the most beautiful park in New York.

In order to provide for the crowds which will arrive over the new Rapid Transit system, which now terminates at 180th Street, a pay entrance will be provided at the southeast corner of the Buffalo Range and Boston Road at 182d Street. From this entrance a direct walk will take visitors to the Antelope House, and another road will be built along the wooded ridge in the Buffalo Range, leading directly to the Bear Dens and Baird Court by way of Beaver Valley. The Motor Road will be connected with Boston Road through the present Buffalo Yards, and when equipped with motor cars for public use, will afford a direct and cheap means of transportation for visitors to any point in the Park.

During the year the City acquired the block bounded by Boston Road, 182d Street and the Zoological Park, which will ultimately be added to the Zoological Park, and enable the Society to provide an adequate entrance and approach to the Riverside Restaurant on Bronx River. Plans for this restaurant and recreation station are under consideration and the building will be constructed during the summer of 1905.

During the coming summer your Committee, in addition to the completion of Baird Court and its approaches, hope to provide the following buildings and installations, in addition to the completion of work under way:

House for Tropical Deer near the present Antelope House.

Camel House.

New Barns and Shops in connection with the Administration Building.

Tortoise Yards adjoining the Reptile House.

Grouse Aviary.

Shelter for the Sea Lion Pool, Baird Court.

Additions to the present series of Fox and Wolf Dens. During the year work on the Elephant House will probably be begun.

FINANCES.

The year 1904 closed with a substantial balance to the credit of the Society in each of its funds, being about the same as last year, although nearly $20,000 has been expended for animals during the past year. Funds for the erection of the Administration Building have not yet been provided and are greatly needed, and special gifts of animals will be required during the coming year.

Animal Fund.—The Animal Fund has been used to sustain and increase the collections, and the moneys derived from the various park privileges, which are increasing slightly every year, have been, as usual, placed to the credit of this fund. The year closed with a credit balance of $3,677.77, as appears in detail in the Treasurer's report.

General Fund.—The dues from members are placed in the General Fund and devoted to the general purposes of the Society, scientific work and game protection. This fund can only be enlarged by an increase in the membership of the Society, which is greatly needed.

Park Improvement Fund.—The Park Improvement Fund was drawn on somewhat heavily to make good the deficiency in maintenance, which it is estimated will amount to $2,500. It is hoped that the necessity of meeting a deficiency in maintenance will be avoided during the year 1905.

Ground Improvement Fund.—The old Ground Improvement Fund, referred to in previous reports, and which was originally appropriated under Mayor Low's administration, has been practically exhausted during the year.

The complete statement of the entire amount appropriated by the Low administration will be found in the Treasurer's report.

The Society received during the year a new Ground Improvement Fund from the City amounting to $275,000, on which your Committee relies largely to develop the Park during the coming year. A further appropriation of like amount is expected during 1905.

Maintenance of the Park (City Fund).—As your Committee stated in last year's report, the Maintenance Fund for 1904 has proved to be inadequate to supply the needs of the Park, even with the strictest economy, and a deficit of about $2,500 will be made good by the Society. This amount would have been much larger had there not been delay in the completion of the Ostrich and Small Mammal Houses. These facts when brought to the attention of the Mayor, and the Board of Estimate and Apportionment, together with the greatly increased requirements for the ensuing year, led to the granting of an increased appropriation for 1905, thus providing the Society, for the first time in its history, with the means to properly maintain the Park. The amount supplied, $134,965, it is believed will be sufficient to prevent a deficiency.

Maintenance for the Aquarium (Aquarium Fund).—The maintenance provided for the Aquarium for 1904 proved sufficient, but owing to the Society's extra economy for the sake of needed improvements, such as an electric lighting plant, which had to be provided from this fund, the City underestimated the requirefents of the Aquarium for the coming year, and the maintenance fund for 1905 was reduced to $45,000. The Society, however, intends to make every effort to keep up the Aquarium to its present standard with this reduced amount. Owing to the decreased quantity of fuel required, resulting from the use of the new outdoor tank, and to other improvements, the amount furnished by the City will probably be sufficient.

Aquarium Improvement Fund.—A bond issue of $40,000 was provided during the year 1904 to meet the need of emergency repairs, which will appear later in this report under the head of Aquarium.

A full statement of all these funds will be found in the Treasurer's report.

GIFTS.

The Society has received during the year many gifts, for which the Committee desires to express the thanks of the Society. A full list of gifts will be found on page 123 of this Report, but special mention should be made of the following:

Gifts of money from Messrs. Percy R. Pyne, Grant B. Schley, Norman James, Frederick Gilbert Bourne.

Riding Elephant from Col. Oliver H. Payne.

Two Snow Leopards from Mrs. Hugh D. Auchincloss.

A Baker's Roan Antelope and five Punjab Wild Sheep from Mr. George C. Clark.

Two Burrhel Sheep from Mr. J. J. Hill.

Collection of Bird Skins, Nests and Eggs from Mr. C. William Beebe.

In addition to the above Mr. Charles T. Barney assumed the burden of providing the entire collection for the new Ostrich House.

The Society received a very notable gift from Dr. Alfred G. Mayer, in the manuscript of his book on Invertebrates in the neighborhood of New York. This book is of great scientific value, as well as public interest, and represents much research and learning on the part of the author. The Executive Committee desires to take this opportunity to express its appreciation of this gift from Dr. Mayer. The Aquarium also received a valuable collection of fish from the St. Louis Exposition, through the courtesy of the Fisheries Bureau at Washington.

COLLECTIONS.

The animal collections of the Zoological Park have been throughout the year so large that it was impossible to make any notable increase in them, save as new installations were erected and made ready for occupancy. In number of large species, and in scientific as well as intrinsic value, the collections are to-day far beyond any point attained heretofore. It has been a standing order of the Executive Committee to the Director that no opportunity to secure desirable specimens should be lost, provided accommodations were available.

During the year two exhibition collections required to be broken up, temporarily, on account of the building of permanent quarters. These were the collections of the temporary Small Mammal House and Pheasant Aviary. A third collection, that

INDIAN LEOPARD.

of Burrowing Rodents, also disappeared temporarily, because of the necessity to renew all the wire-work of the cages, put in concrete floors, and rebuild the rockwork. Next year, however, the complete restocking of these installations will show a marked increase in our total number of species and specimens on exhibition. The collections now comprise 1,802 specimens with 436 species.

MEDICAL DEPARTMENT.

During the year 1904 the Medical Department, under the direction of Dr. Harlow Brooks and Dr. W. Reid Blair, has continued to maintain the high medical standard at the Park, and their discoveries during the year of the causes of cage paralysis, a much dreaded disease among animals in captivity, are set forth in their report in this volume, together with illustrations of great interest. As heretofore stated, data of this character are being accumulated, and will be published under the direction of the Society, and will ultimately form a valuable addition to medical science.

The increased knowledge and experience in the prevention and treatment of diseases and the careful system of quarantine for new animals now provided by the Park has resulted in a constantly declining death rate. The improvements in the installation for our animals, and the replacement of temporary quarters by permanent installations has also resulted in the generally healthy condition of the collections.

MEMBERSHIP.

The membership of the Society on January 1, 1905, was as follows:

Founders	25
Associate Founders	11
Patrons	45
Life Members	179
Annual Members	1,314
Total	1,574
Total last year	1,333
Increase	241

Showing a substantial increase over last year in spite of a large number of deaths. Efforts were made to increase the member-

ship during the past year, with satisfactory results. It is the duty of each member of the Society to supply at least one new member each year. It has been found that only in this manner can the membership of the Society be kept up and enlarged, and our efforts must continue until we are in a sound financial condition with a membership reaching 3,000.

It is believed that a large number of young people could be interested in the work of the Society, and members are invited to use their efforts to get their young people to join the Society.

PUBLICATIONS.

During the year the four regular numbers of the Society's Bulletin have been issued, as well as the Annual Report; and a new edition of the Guide Book was brought out.

GAME PROTECTION.

During the year the interests of game protection were seriously menaced by a bill introduced by Senator Dillingham of Virginia, repealing, in the alleged interest of the natives, practically all the restrictions on the slaughter of game in Alaska. The Society opposed this bill vigorously, and the measure has been practically abandoned, although still in the Senate Committee.

A similar attempt was made on a smaller scale in the State of New York by the enemies of game preservation, by means of a bill introduced in the Assembly which sought to repeal the law prohibiting the spring shooting of ducks. This bill was also opposed by the Society and ultimately defeated.

During the year other successful efforts have been made looking toward the protection of game, more particularly birds, in connection with the League of American Sportsmen, and otherwise.

At the International Zoological Congress held at Berne, Switzerland, the Society was ably represented by Prof. Henry Fairfield Osborn, its Vice-President.

AQUARIUM.

During the year 1904 the attendance was 1,625,770, an increase over 1903 amounting to 77,879, making the average daily attendance through the year 4,454. The increased attendance was doubtless due to the fact that the building was kept open

two hours longer each day during the summer season, and that the Society has discontinued the closing of the building on Thursday forenoons.

The collections of the building have been larger and more varied than heretofore; profitable exchanges having been made with the new aquarium at Detroit and the Government aquarium at the St. Louis Exposition. At the close of the Exposition the greater part of the Government collection was transferred to the New York Aquarium, through the courtesy of the Bureau of Fisheries.

The improvement of the building from the proceeds of the $30,000 of bonds by the city has been continued.

The large reservoir for pure sea-water has been completed and only awaits the installation of the filters, in order to be placed in commission.

The work on sky-lights, painting and certain alterations has been finished.

A further bond issue, granted by the city in the spring of 1904, of $40,000 has permitted the continuance of work connected with the more complete equipment of the building for the carrying on of its work as a notable public institution.

Pipe galleries under the main floor are now being constructed, and this work will be followed by the introduction of a much-needed heating and ventilating system.

Among the improvements made from the maintenance may be mentioned the introduction of electric lights over all wall tanks, for the illumination of the exhibits on dark days. This improvement has been a most satisfactory one.

The collection of invertebrates has been enlarged by the placing of eighteen thirty-inch aquaria on the coping of the central pool; while the collection of turtles has been accommodated in nine three-foot aquaria, placed on the main floor between the pillars.

The work of labeling exhibits has been continued. A photographic room has been built, and additional rock-work has been placed in various tanks.

The fish-hatchery was in operation throughout the winter season, and proved a constant source of interest to visitors. Fish eggs were furnished by the Government, and the young fish turned over to the New York Fish Commission for the stocking of State waters, as usual. During the fish-hatching season the eggs and young of eight species of food fishes were kept on exhibition. Small fishes and marine invertebrates from the

surplus stock, brought in by the collector from time to time, were supplied liberally to the teachers of biology in the public schools.

DEATHS.

The Committee announces with great regret the death of one of its best friends, a member of the Board of Managers, Class of 1907, Hon. William C. Whitney, whose gifts to the Society amounted to nearly $20,000; also of Mr. Joseph Stickney, a member of the Board of Managers, Class of 1905. The vacancies caused by the death of the above managers were filled by the election of Mr. Frederick Gilbert Bourne, Class of 1907, and of Mr. Grant B. Schley, Class of 1905.

The Society also sustained the loss of an Honorary Member, Monsieur F. L'hoëst, Director of the Zoological Society of Antwerp.

ACKNOWLEDGMENTS.

Before closing this report your Committee wishes to express its sense of appreciation of the cordial co-operation of the Mayor and Comptroller, as well as of the Park Commissioners of the Boroughs of Manhattan and The Bronx. All these gentlemen have been very helpful to the Society, and have shown an earnest desire to facilitate and extend its work.

To the Director of the Zoological Park, and to all members of his staff, the Committee again desire to acknowledge their appreciation of unflagging zeal in the interests of the Society. The good work of all the members of the Park force has been so uniform that it is impossible to single out any one individual.

The thanks of the Committee are also due to the Director of the Aquarium and his assistants, and the constant increase in the attendance of this institution testifies to their zeal and energy.

Respectfully submitted,

CHARLES T. BARNEY, *Chairman.*

HENRY FAIRFIELD OSBORN, MADISON GRANT,
JOHN S. BARNES, PHILIP SCHUYLER,
WILLIAM WHITE NILES, SAMUEL THORNE,
LEVI P. MORTON, *Ex-officio.*

January 1, 1905.

A BRIEF HISTORY OF THE LANDSCAPE AND FORESTRY WORK IN THE NEW YORK ZOOLOGICAL PARK.

IN July, 1898, the New York Zoological Society took possession of all that portion of the Bronx Park lying south of Pelham Avenue, and now known as the New York Zoological Park. The land committed to its care was found by the Society in a wild and totally neglected condition, with features of great natural beauty, but bearing many marks of vandalism. This area included the former estate of the Lydig family, who had cultivated portions of it, and for eighty years had carefully protected and preserved the beautiful native forest.

The Executive Committee realized that the installation of a zoological collection in this park required expert knowledge, and the landscape features of the problem have received the constant attention both of the members of the Committee and of the landscape architects employed by them. The first plan for the development of the Park was prepared and submitted by Director William T. Hornaday in November, 1896. The buildings and installations were located on it with special reference to the needs of the various animals, and the availability of building sites. While the æsthetic treatment of this plan has been submitted to and modified by the various experts, the original scheme has been adhered to very closely, and reflects great credit on the foresight and skill of Mr. Hornaday.

This preliminary plan passed through various stages, and ultimately became the "final plan," which was formally adopted by the Executive Committee on November 27, 1897. With the exception of Baird Court and its approaches, the landscape features of this plan were developed by Mr. Charles N. Lowrie in cooperation with the Director, and the portion of the plan relating to Baird Court was the work of Messrs. Heins & La Farge.

In 1899 Mr. Warren H. Manning, of Boston, was engaged to make a study of this final plan, and he made several important suggestions, some of which were adopted. At this juncture the practical development of Baird Court presented great difficulties,

and by the advice of Mr. Manning the original design for this Court as incorporated in the final plan was discarded. The architectural treatment of the buildings themselves, planned by Messrs. Heins & La Farge, was, however, retained in its entirety. The study of Baird Court in relation to its natural surroundings was then taken up. The direction of its axis, its levels, and the motor road along its western side were determined by Prof. Henry Fairfield Osborn, at that time Chairman of the Executive Committee, acting in consultation with Mr. John DeWolf, then landscape architect of the Park Department, and with Mr. H. A. Caparn, who had in the meantime been appointed the landscape architect of the Society. Mr. Caparn served the Society in this capacity from 1899 to the end of 1904, and his plan of Baird Court, and the approach from the north, known as the Concourse, was formally adopted by the Executive Committee on November 14, 1900, after having been submitted to the expert consideration of Mr. Charles F. McKim, and approved by him. This plan was published in the Society's fifth Annual Report.

The architectural features of the general design of Baird Court, along the lines laid down in the Caparn plan, have again been submitted to Messrs. Heins & LaFarge, and their general combination of architectural with landscape features has been approved by the Executive Committee, and is now being carried out.

In the meantime much attention has been paid to the care and preservation of the forest, and to the whole subject of planting, both for the present and in the future. All suggestions received from those who have been connected with the landscape development of the Park have been carefully considered, and sectional plans of the planting have been made from time to time by our Chief Forester, Herman W. Merkel. The plans have been considered separately, and most of them carried out. Mr. Merkel had, of course, full benefit of the advice of the various landscape architects employed.

The general plan of the planting and forestry of the Park has been to encourage the perpetuation of local types of flora, rather than an introduction of exotics either from the extreme north or south of our country. This purpose has been carried out as far as possible, even in bushes and shrubbery, although in some instances slight departures from this principle have been made. The Executive Committee also has laid it down as a general principle that formal planting of any kind should be confined to Baird Court and its main approach. The remainder

of the Zoological Park will, as far as possible, be kept in its natural condition.

In addition to the protection of the existing forests, a screen of thick planting will be provided along the southern and western boundaries of the Park, to shut out from the interior any unsightly buildings that may be erected along the bordering avenues. In connection with the work of the forests, 230 trees have been removed, mostly on account of the decay incident to old age, or as a result of storms. This large number is due to the fact that when the Society took charge of the Zoological Park grounds many of the trees were dead, and many more were in a dying condition. At least forty trees have been blown down by wind storms. About 1,500 trees have been treated for preservation, and 2,015 new trees have been planted up to January, 1905. During the spring of 1905 many hundred additional trees will be planted. About 4,526 vines and shrubs have been planted, and 4,608 perennials have been set out. In some places where the need of shade was imperative, quick-growing maples and poplars have been planted for temporary purposes. At the same time, more desirable species, but of slower growth, such as pines, oaks and tulips, have been set out in order that as soon as the latter have attained satisfactory size, the temporary plantings can be cut out.

The original plan of the Park was laid out with reference to the approach of the largest number of visitors from the northwest corner, by way of the Harlem Railroad and the Manhattan Elevated road. The Rapid Transit system, unexpectedly terminating at our southern border, at West Farms, has necessitated a complete reconsideration of the Park approaches from the southeast. The plans for these approaches have been referred by the Executive Committee to a subcommittee on plans, consisting of Messrs. Barney, Osborn and Grant, in conjunction with Mr. James L. Greenleaf, who had been engaged by the Society as Consulting Landscape Architect in January, 1905.

It is the intention of the Executive Committee to provide for an entrance at the extreme southeast corner of the Buffalo range, so that visitors can enter the enclosed area of the Park within two short blocks of the actual terminus of the Rapid Transit system. From this new entrance a walk is planned through the Buffalo range and joining the Beaver Valley Walk to Baird Court. This, in connection with Osborn's Walk, will make a diagonal line of highly attractive paths from the northwest corner to the southeast entrance of the Park. From the

West Farms Entrance another path will lead directly to the Antelope House, the nearest animal building. The Committee anticipates that during the next few years the majority of visitors will reach the Park over the Rapid Transit system, and through this southern entrance. As the City develops, however, and new areas toward the north become more thickly populated, the entrances on the north side of the Park will also be called upon to accommodate great crowds, and they will be developed accordingly.

The main route from Manhattan to the Park by carriages and automobiles will be through the Grand Boulevard and Concourse now under construction, and along Pelham Avenue, directly to Baird Court. The approach from Pelham Avenue to Baird Court will be known as the Concourse, and will be the formal architectural entrance to the main animal buildings.

MADISON GRANT.

March 1, 1905.

LIST OF TREES AND SHRUBS FOUND IN THE NEW YORK ZOOLOGICAL PARK IN BRONX PARK.

Red Maple	*Acer rubrum.*
Sugar Maple	*Acer saccharum.*
Tree of Heaven	*Ailanthus glandulosa.*
Alder	*Alnus rugosa.*
Angelica Tree	*Aralia spinosa.*
Swamp Honeysuckle	*Azalea nudiflora.*
Swamp Honeysuckle	*Azalea viscosa.*
Benzoin	*Benzoin benzoin.*
White Birch	*Betula alba.*
Sweet Birch	*Betula lenta.*
Poplar-leaved Birch	*Betula populifolia.*
Common Barberry	*Berberis vulgaris.*
Hornbeam	*Carpinus caroliniana.*
Chestnut	*Castanea vesca.*
Catalpa	*Catalpa catalpa.*
Catalpa	*Catalpa speciosa.*
Shad-berry	*Celtis occidentalis.*
Button Bush	*Cephalanthus occidentalis.*
Virgin's Bower	*Clematis virginiana.*
Sweet Pepperbush	*Clethra alnifolia.*
Dogwood	*Cornus alternifolia.*
Kinnikinnik	*Cornus amomum.*
Cornel	*Cornus candidissima.*
Flowering Dogwood	*Cornus florida.*

Red-twigged Osier	*Cornus stolonifera.*
American Hazel	*Corylus americana.*
Scarlet Haw	*Crataegus oxyacantha.*
Deutzia	*Deutzia coronata.*
Weigelia	*Diervilla diervilla.*
American Burning Bush	*Euonymus americanus.*
American Beech	*Fagus americana.*
American Ash	*Fraxinus americana.*
Pennsylvania Ash	*Fraxinus pennsylvanica.*
Honey Locust	*Gleditsia triacanthos.*
Kentucky Coffee Tree	*Gymnocladus canadensis.*
Witch Hazel	*Hamamelis virginiana.*
St. John's Wort	*Hypericum mutilum.*
Butternut	*Juglans cinerea.*
Black Walnut	*Juglans nigra.*
Red Cedar	*Juniperus virginiana.*
Laurel	*Kalmia augustifolia.*
Sheepkill	*Kalmia latifolia.*
Larch	*Larix laricina.*
Box-leaved Privet	*Ligustrum buxifolium.*
Lilac	*Ligustrum vulgare.*
Sweet Gum	*Liquidambar styraciflua.*
Tulip Tree	*Liriodendron tulipifera.*
Honeysuckle	*Lonicera brachypoda.*
Sour Gum	*Nyssa sylvatica.*
Syringa	*Philadelphus coronarius.*
White Pine	*Pinus strobus.*
Buttonwood	*Plantanus occidentalis.*
White Poplar	*Populus alba.*
Lombardy Poplar	*Populus fastigiata.*
Large-toothed Poplar	*Populus grandidentata.*
American Aspen	*Populus tremuloides.*
Bird Cherry	*Prunus avium.*
Black Cherry	*Prunus serotina.*
White Oak	*Quercus alba.*
Pin Oak	*Quercus palustris.*
Swamp White Oak	*Quercus platanoides.*
Red Oak	*Quercus rubra.*
Black Oak	*Quercus velutina.*
Sumach	*Rhus glabra.*
Poison Sumach	*Rhus toxicodendron.*
Yellow Locust	*Robinia pseudacacia.*
Swamp Rose	*Rosa carolina.*
Pasture Rose	*Rosa humilis.*
Low Blackberry	*Rubus canadensis.*
Black Raspberry	*Rubus occidentalis.*
Common Blackberry	*Rubus villosus.*
White Willow	*Salix alba vitellina.*
Weeping Willow	*Salix babylonica.*
Glaucous Willow	*Salix [illegible]*

Black Willow	*Salix nigra.*
Slender Willow	*Salix petiolaris.*
Silky Willow	*Salix sericea.*
Elderberry	*Sambucus canadensis.*
Sassafras	*Sassafras sassafras.*
Common Catbrier	*Smilax rotundifolia.*
Lilac	*Syringa vulgaris.*
Trumpet Vine	*Tecoma radicans.*
American Linden	*Tilia americana.*
Hemlock	*Tsuga canadensis.*
Elm	*Ulmus americana.*
Blueberry	*Vaccinium vacillans.*
Sheepberry	*Viburnum dentatum.*
Arrow-wood	*Viburnum acerifolium.*
Sweet Viburnum	*Viburnum lentago.*
Black Haw	*Viburnum prunifolium.*
Summer Grape	*Vitis aestivalis.*
Northern Fox-grape	*Vitis labrusca.*
Weigelia	*Weigela rosea.*
Wistaria	*Wistaria sinensis.*

H. W. M.

Treasurer's Reports.

FOR THE YEAR ENDING DECEMBER 31, 1904.

The annual expenditure of the various funds is shown in appended statements.

Park Improvement Fund.

RECEIPTS.

Cash in Treasury, January 1, 1904		$8,380.75
Subscriptions:		
Grant B. Schley	$1,000.00	
E. H. Harriman	500.00	
Frederick G. Bourne	5,000.00—	6,500.00
		$14,880.75

EXPENDITURES

General Expenses	$142.26	
Alaskan House	871.61—	$1,013.87
Cash in Treasury, January 1, 1905		13,866.88
		$14,880.75

H. R. MITCHELL.
Chief Clerk

PERCY R. PYNE
Treasurer.

January 1, 1905.

Examined and found correct by the New York Audit Company.

General Fund.

RECEIPTS.

Cash in Treasury, January 1, 1904		$2,840.14
Annual Dues from Members	$11,710.00	
Life Membership Fees	4,400.00	
Stokes' Bird Fund	150.98	
Miscellaneous Receipts	25.00—	16,285.98
		$19,126.12

EXPENDITURES.

Office Furniture and Fixtures	$95.50	
Stationery and Office Supplies	882.56	
Photographs and Slides	940.74	
Annual Report	2,218.85	
Bulletin	893.52	
Miscellaneous Expenses and Supplies	681.22	
General Office Expenses	1,882.59	
Treasurer's Office Expenses	513.80	
Library	887.16	
Salary of Secretary	4,000.00	
Mailing Circulars	1,062.01	
Employers' Insurance	306.08	
Sportsmen's Show Exhibit	396.49	
Publications for Members	78.01	
League of American Sportsmen	337.55	
McCabe Damage Suit	244.30	
Audit of Accounts	125.00	
Interest	178.30	
Aquarium Publications	236.32—	$15,960.00
Cash Balance in Treasury, January 1, 1905		3,166.12
		$19,126.12

H. R. MITCHELL,
Chief Clerk.

PERCY R. PYNE,
Treasurer.

January 1, 1905.

Examined and found correct by the New York Audit Company.

Animal Fund.

RECEIPTS.

Cash in Treasury, January 1, 1904			$2,230.86
Receipts at Park:			
Admissions		$5,421.90	
Checking		25.05	
Rents		532.87	
Sale of Animals		945.00	
Miscellaneous Receipts		390.05	
Boating		375.00	
Special Subscriptions:			
George C. Clark	$365.25		
J. J. Hill	438.30		
Oliver H. Payne	2,500.00		
Nelson Robinson	400.00		
Norman James	2,300.00		
Mrs. Hugh D. Auchincloss	900.00		
George C. Clark	575.00		
Percy R. Pyne	1,000.00		
Charles T. Barney	1,000.00	9,478.55	
Privilege Account (Season of 1904)		4,000.00	21,168.42
			$23,399.28

EXPENDITURES.

Purchase of Animals:			
Mammals		$15,400.96	
Birds		1,941.99	
Reptiles		754.83	$18,097.78
Express and Other Charges			959.73
Traveling and Other Expenses			664.00
Cash in Treasury, December 31, 1904			3,677.77
			$23,399.28

H. R. Mitchell,
Chief Clerk.

Percy R. Pyne,
Treasurer.

January 1, 1905.

Examined and found correct by the New York Audit Company.

Maintenance Fund.

RECEIPTS.

Received from the City on Account of Maintenance Appropriation of $104,965.00 for the year	$99,964.79	
Balance due from City on account of Maintenance	5,000.21	—$104,965.00
Shortage for the year		1,894.37
		$106,859.37

EXPENDITURES.

General Administration	$10,726.58	
Maintenance of Buildings and Care of Animals	30,611.99	
Maintenance and Care of Grounds	27,677.13	
Tools and Hardware	1,971.65	
Paints and Oils	1,330.09	
Office Supplies and Printing	679.57	
Horses and Vehicles	369.13	
Repairs	535.39	
Telephone and Electrical Supplies	23.60	
Telephone Service and Tolls	650.41	
Postage, Telegraph and Express	812.45	
Food for Animals	19,791.97	
Fuel	5,081.99	
Drugs and Medicines	240.58	
Lumber	1,080.38	
Miscellaneous Supplies	1,011.97	
Plumbing Supplies	455.50	
Electric Lighting	132.92	
Sand	251.67	
Nursery Stock and Seeds	53.73	
Medical Attendance (Animals)	315.00	
Nursery Supplies	248.22	
Office Furniture and Fixtures	154.50	
Uniforms and Badges	696.75	
Fencing and Netting	652.38	
Signs and Labels	326.90	
Engineering Supplies	55.67	
Surgical Instruments and Appliances	46.97	
Sanitation	168.44	
Ice	365.74	
Cement	11.10	
Rubber Hose	196.25	
Park Baskets	131.25	
Medical Attendance (Employees)	1.50	—$106,859.37

H. R. Mitchell,
Chief Clerk.

Percy R. Pyne,
Treasurer.

January 31, 1905.

Examined and found correct by the New York Audit Company.

Ground Improvement Fund Statement.

(Showing Expenditure of Appropriation No. 3.)

RECEIPTS.

Appropriation of Board of Estimate and Apportionment, Available May 18, 1902	$250,000.00	
Available February 20, 1903	75,000.00	
Available July 5, 1903	175,000.00	
Premium on Sale of Bonds to Dec. 31, 1904	4,444.27	$504,444.27

EXPENDITURES.

Through Park Department:		
Contract, Thos. Dwyer, Antelope House	$54,900.00	
Contract, William H. Wright & Son, Bear Dens	4,877.00	
Contract for improving West Farms Road,	3,754.70	
Miscellaneous Expenditures by Park Department	4,160.76	
Over expenditure last appropriation	95.58	
Contract, George L. Walker Co., Small Mammal and Ostrich Houses	73,780.00	
Contract, George L. Walker Co., Large Bird House	115,644.00	
Contract, Page Woven Wire Fence Co., Antelope House Yards	8,713.00	
Contract, Julian Scholl & Co., Steam Roller	1,890.00	
Judgment of T. W. Timpson & Co., account work performed on abandoned contract	1,140.00	
Contract, William Horn Co., Iron Fence, Sea Lion Pool	1,520.00	$270,481.04
By the Zoological Society:		
Bill to reimburse Park Improvement Fund, account advanced to complete buildings on Baird Court:		
Monkey House	$5,374.77	
Lion House	9,262.16	
Antelope House	1,189.00	$15,825.93
Guard rails	4,369.50	
Seeds and plants	1,002.95	
Public Comfort Building, No. 1	210.50	
Bear Dens, addition	9,333.35	
Mountain Sheep Hill	3,831.51	
Buffalo Range Drainage	2,331.50	
Beaver Valley Walk	4,191.71	
Grading and seeding	4,596.87	
Drainage Elephant House site	256.31	
Baird Court Retaining Wall	155.80	
Baird Court Walks	23,209.24	
Beaver Pond	38.25	
Brought forward	[illegible]	$286,306.07

Brought forward	$53,524.49	$286,306.97
Buffalo and Restaurant water main	549.87	
Machinery, tools, and hardware	874.04	
Photograph Gallery	95.54	
Crematory	425.71	
Grading and seeding Auto Road	192.38	
Bronx River Walk	9,138.66	
Antelope House	2,632.95	
Lion House	13,036.18	
Miscellaneous fencing and netting	952.58	
Improvements East of Bronx River	2,229.99	
Pavilion No. 3	90.00	
Corrals and Walks	122.38	
Miscellaneous ground improvement items,	20,455.40	
Mountain Sheep Walk	875.62	
Breeding House	944.84	
Reptile House Improvements	183.44	
One Hundred Park Benches	595.00	
Grading and seeding Beaver Valley Walk.	681.42	
Tortoise Room, Reptile House	1,373.82	
Electric lighting, Reptile, Mammal and Bird Houses	959.57	
Lydig Gate Foundation	233.15	
Llama House Yards	948.73	
Boundary Fence along the entire Eastern Boundary	3,064.44	
Water Supply for Italian Fountain	300.49	
Bird Enclosure	380.40	
Red Deer Range, drainage	442.52	
Trimming, pruning, and planting	8,098.75	
Ducker Portable Houses	573.50	
Corral for Wild Horses	682.65	
Miscellaneous materials and supplies	1,278.66	
Mammal Pond Fence	798.30	
Lion House (outside cages)	4,165.88	
Bird House (large). Arch. commission, sculptures, etc	6,685.10	
Abattoir and Stable	990.91	
Antelope House Yards	16,935.01	
Lion House Walks	1,257.77	
Cement	232.55	
Buffalo Range Division Fence	599.46	
Soda Pavilion	611.51	
Small Mammal House	2,678.49	
Ostrich House	2,501.17	
Removal of Mammal House to Nursery	800.00	
Llama House	2,148.70	
Additional Wall, Prairie Dog Village	297.17	
Mammal House Fence	143.07	
Sika Deer Shelter	225.00	
Buffalo Corrals	523.18	
Artists' Room, Lion House	222.50	
Fallow Deer Shelter and Yard	424.64	
Animal Storehouse	1,105.98	
Storage Shed at Nursery	78.40	
Deer Barn	4,413.05	
Nursery Water Supply	892.50	
Altai Wapiti Shelter	288.32	
Brought forward	$174,955.83	$286,306.97

Brought forward	$174,955.83	$286,306.97
Deer Barn Walks and Yards	7,868.73	
Reconstruction of Walks	24,041.67	
Plowing Elk and Buffalo Ranges	206.78	
Electric Conduit	2,220.60	
Extension to Office	430.54	
Sea Lion Pool, rockwork	185.85	
Burrowing Rodents' Quarters	2,110.33	
Ostrich and Mammal House Walks and Yard	2,010.55	$214,030.88
Unexpended Balance Carried to New Account		4,106.42
		$504,444.27

H. R. MITCHELL,
Chief Clerk.

PERCY R. PYNE,
Treasurer.

January 31, 1905.

Examined and found correct by the New York Audit Company.

Aquarium Improvement Fund.

(Showing Balance of Appropriation of $30,000 and Status of Appropriation of $40.000.)

RECEIPTS.

Balance of $30,000 Appropriation, as per Report for 1903..	$3,386.70
Appropriation of Board of Estimate and Apportionment in 1904	40,000.00
Premium, account Sale of Bonds	241.27
	$43,627.97

EXPENDITURES.

Christopher Nally, account balance on underground reservoir	$916.00	
Christopher Nally, account changes in Plumbing	589.00	
Barney and Chapman, Architects' Commissions,	75.25	
Charles Wille, Construction of Underground Conduits	12,424.00	
Barney and Chapman, Architects' Commissions	621.20	
Charles Wille, Installing Filters	3,000.00	
Barney and Chapman, Architects' Commissions	150.00	
Charles Wille, Changing Conduits	500.00	
Barney and Chapman, Architects' Commissions,	25.00—	$18,300.45
Balance Available for Expenditure		25,327.52
		$43,627.97

E. R. Sampson,
Disbursing Clerk.

Percy R. Pyne,
Treasurer.

January 1, 1905.

Examined and found correct by the New York Audit Company.

Aquarium Fund.

RECEIPTS.

Received from City on account of Aquarium appropriation of $46,500 for 1904	$46,500.00

EXPENDITURES.

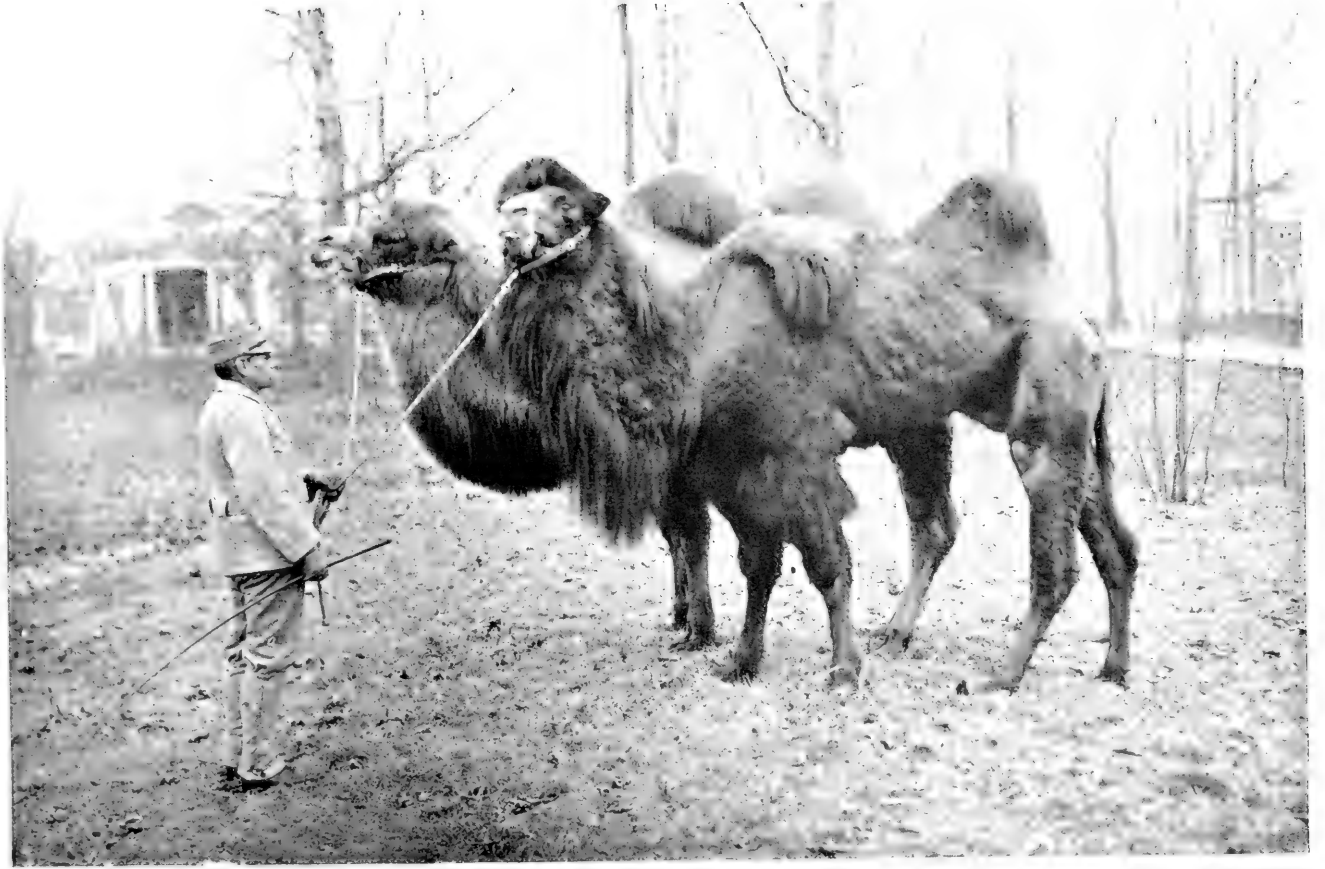
Payroll for Employees	$27,228.05	
Payroll for Painters	1,118.00	
Alterations	3,921.82	
Coal (for ten months)	3,235.31	
Live Specimens	1,951.82	
Fish Food	1,272.03	
Gas	682.65	
Ice	55.99	
Telephone Service	190.05	
Incidental Expenses	500.00	
Uniforms	28.50	
Books for Library	139.60	
Furniture	249.50	
Supplies (General)	2,806.55	
Stationery and Printing	157.00	
Wiring for Electric Light	1,078.00	
Cartage (Fish and Cans)	259.85	
Two Deane Pumps	1,565.00	$46,439.72
Nominal Balance Unexpended		60.28
		$46,500.00

E. R. Sampson,
Disbursing Clerk.

Percy R. Pyne,
Treasurer.

January 1, 1905.

Examined and found correct by the New York Audit Company.



PAIR OF BACTRIAN CAMELS.

Gift of Capt. John S. Barnes.

REPORT OF THE DIRECTOR

OF THE

ZOOLOGICAL PARK

TO THE BOARD OF MANAGERS.

IN our general scheme of development, the year just closed has witnessed the greatest activity and progress of any year since 1899. At no previous time has the administrative machinery of the Park been in more perfect working order, or so fruitful of results in proportion to the efforts and expenditures put forth. In anticipation of the great increase in attendance that seems likely to follow the completion of the Interborough Railway line to the West Farms Entrance of the Zoological Park, special efforts were put forth to carry the improvement of the Park as far as possible toward completion. More buildings and collections are needed, and new walks leading to them must be built as rapidly as possible. Animals are constantly accumulating faster than exhibition facilities can be provided for them, and one of our chief sources of worry is in providing for a surplus of valuable animals with which we are unwilling to part.

DEPARTMENTAL RELATIONS.

Throughout the year 1904 the Zoological Park continued to enjoy the friendship and assistance of the Mayor, the Comptroller, and the Board of Estimate and Apportionment; and the Commissioner, Engineer, and Chief Clerk of the Park Department of Bronx Borough. Captain Jefferson Deevy, in command of the Forty-first Precinct, Metropolitan Police, very kindly did everything in his power to promote the successful operation of the Zoological Park, and to protect impartially the interests of the public and of the Zoological Society. The police service of the Park was admirably maintained, but on a strictly economical basis. A number of arrests were made during the year, and in

nearly every case a conviction was secured—chiefly for the violation of rules that have been adopted for the preservation of public property.

ATTENDANCE.

With the continued development of the Park, new efforts are made to provide for the comfort of visitors, and to make the collections more interesting to them. Much remains to be done in increasing the number of public comfort stations, and with the new funds now available, the Society intends to take important steps in that direction. Two new buildings are to be erected at an early date, the most important of which will be the boat-house and restaurant near the West Farms Entrance.

The total attendance of visitors during the year 1904 was 1,104,616. The largest attendance in a single day was 39,132, on May 22d. The monthly attendance was as follows:

January	19,798
February	19,547
March	55,303
April	88,148
May	227,484
June	128,067
July	147,015
August	156,460
September	129,259
October	71,694
November	48,105
December	13,736
Total	1,104,616

HEALTH OF THE ANIMALS.

The constant improvements in our installations for animals, the replacement of temporary quarters by others of a permanent character, and increased knowledge in the prevention and treatment of disease, naturally has resulted in healthier animals and a lower death-rate. The presence of a skilled veterinarian on the Zoological Park staff has proven of great value not only to the Society's collections, but also, as we believe, to zoological gardens in general. Dr. Blair's vigilance in the detection of disease, and the prompt isolation and treatment of all cases, particularly those of either a suspected or declared infectious nature,

has been fruitful of excellent results, and the value of his work is steadily increasing.

Only those who are in or near the storm-center can appreciate the extent to which unexpected, and often deadly, diseases and parasites are constantly being brought from all parts of the habitable globe by the living animals which come into a large zoological garden or park. Our Veterinarian and the Director agree in the belief that we are destined to receive here all the diseases and parasites that wild animals are heir to, and while closely guarding all avenues of approach we need be surprised by nothing.

Thanks to the continuous struggle that has been made ever since the Zoological Park opened, by every one either directly or indirectly connected with the welfare of our animals, the death rate amongst our mammals has been brought down from 24 per cent in 1900 to 16 2-3 per cent in 1904. It should be noted at this point, however, that while in figures the annual death loss in every large zoological garden seems very large, about three-fourths of the total number of deaths are of small, inexpensive and short-lived animals. By eliminating the smaller carnivores, rodents, edentates, marsupials, and short-lived primates, it would be a comparatively easy matter to bring an annual death rate down to 8 or 10 per cent; but the end thereby attained would not justify the means.

The poisonous nature of all the grasses in the Zoological Park meadow ranges, both wild and cultivated, has been strikingly apparent in the ranges of Mountain Sheep Hill. After many experiments, and much grass sickness amongst the wild sheep and goats kept in those enclosures, we have been compelled to choose between animals and grass. Nothing remains but to uproot every square foot of green turf on Mountain Sheep Hill, and this will be done early in the coming spring. We will then be enabled to regulate absolutely the food supply of our large and valuable collection of wild sheep and goats.

Fortunately, the most valuable animals in the Park are the ones which thrive best, and seem resolved to live longest. Since the opening of the Antelope House (November 9, 1903), there has been but one fatality in that collection. A small reduncа antelope died of tuberculosis—the only case of that dread disease amongst our mammals for the entire year. The anthropoid apes are the healthiest and most active of all the animals in the Primates' House, and they are growing more rapidly than any others. During the year 1904 the only loss in the Lion House—aside from imperfect lion cubs—was the female snow leopard which

CAGE FRONT IN SMALL MAMMALS' HOUSE.

escaped and was shot to death. All the foreign deer have been maintained in excellent health, but our native *Cervidae* have not done equally well.

COLLECTIONS.

Although the beginning of 1904 found the Zoological Park in possession of as many living mammals, birds, and reptiles as its installations could well accommodate, the temptation to secure additional specimens of special rarity and scientific value could not always be resisted. As a result, the end of the year found all animal quarters, except a few reserved cages in the Small-Mammal House, full to overflowing. When rare and long-desired types finally become procurable, it is often impossible to refrain from acquiring them.

DEPARTMENT OF MAMMALS.

In gifts to the mammal collections, the most noteworthy event of the year was the arrival from southeastern Germany of a fine

pair of European bison, which came from the forest of the Prince of Pless, as the gift of Mr. Norman James, of Baltimore. These animals were quartered at the Buffalo Entrance, and are the first living specimens to be seen by visitors after entering the closed grounds. Next in zoological importance was the acquisition of a pair of young mountain goats, from Fort Steele, Alberta, the first ever exhibited alive in New York City. Up to the end of the year these strange animals had thriven satisfactorily, and it is hoped the species can be acclimatized here with a fair degree of success.

A fine tusk elephant, about seven feet in height, was imported direct from Assam, northern India, and was very successfully broken for riding by Keeper Frank Gleason. This animal was the gift of Col. Oliver H. Payne. During the latter half of the warm season, "Gunda" regularly carried visitors, and besides earning an income, proved a very interesting exhibit. Thus far, all efforts to secure an African elephant have been unavailing, on account of the scarcity of elephants throughout Africa generally, and the infrequency of captures.

From Mrs. Hugh D. Auchincloss two female snow leopards, from Central Asia, were received as a gift. These animals were, after due precautions, placed in the large outside cage occupied by the fine male snow leopard—also the gift of Mrs. Auchincloss—and visitors to the Park enjoyed the rare opportunity of seeing three snow leopards living in one cage. Unfortunately, however, the trio was finally broken up by the escape of a female through a skylight, and her unfortunate and uncalled-for destruction before any Park officer could reach the scene, and take steps for her recapture.

During the year, two exhibition collections required to be temporarily broken up. The temporary Small-Mammal House was removed to the Nursery, to do duty as a permanent greenhouse, and the small mammals it contained were stored in the Animal Yard during the erection of the permanent Small-Mammal House. The Burrowing-Rodents' Quarters became infested with rats, which killed most of the small rodents, and rendered it necessary to construct concrete floors a few inches below the earth. It was also found that the more timid of the rodents spent so many daylight hours deep down in their burrows, the public derived little benefit from them. It was therefore decided to construct burrows, or shelter-boxes, above ground, in the rock piles, in such a manner that the whole interior of each burrow might easily be opened and examined. At the same time, new wire was placed

YOUNG RACCOONS.

over the whole structure, to take the place of that which had become badly rusted.

The completion of the new Small-Mammal House late in November, rendered it possible to open that building to the public on December 25th, which was done. It contains the general mixture of odd small mammals which was originally contemplated —small carnivores, tropical rodents, marsupials, tropical swine, and not a few small antelopes and deer that should be elsewhere. No haste has been made in filling all the small cages of this building, for it seems desirable to make the final selections of types with considerable care. At present the most important species exhibited in this building are the hyena dog, Malay sun bear, Yaguarundi cat, genet, serval, bush-tailed meercat, white-whiskered paradoxure, beaver, Indian porcupine, red river-hog, and peccary. Several kangaroos and other marsupials will be added forthwith. The horned ungulates are out of place, and will be removed at the earliest opportunity.

On account of the annoyance and disappointment to visitors caused by the persistence of the beavers of the Beaver Pond in keeping out of sight, a pet beaver is kept in the Small-Mammal House where it can be seen to good advantage.

Both in preserving the lives of its living animals, and in properly exhibiting them to the public, the Small-Mammal

House promises to render all the service that was expected of it.

Another noteworthy event in the Mammal Department was the completion and occupancy of the installation for Asiatic deer, as described in detail in Bulletin No. 15.

The collection of hoofed animals is now assuming proportions which render it worthy of serious consideration, but the creation of three more installations are necessary to give it a place in the first rank. A spacious house for small deer and antelopes is greatly needed, the plans for it are nearly ready, and it will be erected in 1905. It will be followed closely by the building of an installation for wild horses, zebras, and wild asses, and another for tropical wild cattle, bison, and buffaloes.

At the close of 1904, our collection of hoofed animals stood as follows:

HOOFED ANIMALS.

Bison and Buffalo	3	species.	35	specimens.
Antelopes	15	"	23	"
Giraffe	1	"	2	"
Goats and their allies	4	"	7	"
Sheep	3	"	10	"
Wild Swine	2	"	2	"
Cameloids	4	"	7	"
Elephant	1	"	1	"
Equines	2	"	4	"
Deer	17	"	128	"
	52	"	219	"

The ungulate collection of the Zoological Park never before has been of as great zoological importance and intrinsic value as now; and it may be added that it has never before been so costly to maintain. During 1904 not one death occurred in the Antelope House, and all the members of that already-famous collection were kept in most perfect health. The American deer, below the size of the elk, have done poorly; but all the foreign deer are in most perfect health. The bison herd is in fine condition. The elephant is full of vigor, and while quite good-tempered and tractable, he seems to think it is his duty to destroy everything in and about his stall, that can be broken.

SUMMARY OF MAMMALS ON DECEMBER 31, 1904.

Primates	34	species.	88	specimens.
Cheiroptera	1	"	1	"
Carnivora	48	"	133	"
Pinnipedia	3	"	7	"
Rodentia	13	"	64	"
Ungulata	52	"	219	"
Edentata	1	"	1	"
Marsupialia	2	"	3	"
	154	"	516	"

DEPARTMENT OF BIRDS.

In this department the most important events of the year were the beginning, and two-thirds completion, of the large Bird House, the completion of the Ostrich House, and the beginning of the Pheasants' and Doves' Aviary. The temporary Pheasants' Aviary was removed and devoted to other purposes than the exhibition of birds, and the collection it had contained disappeared from exhibition. On account of the plans for the rebuilding of this aviary, no efforts were made to increase the collection, either by breeding or purchases.

The completion of the Ostrich House, and its opening on December 25th, afforded great relief to the Bird Department. Several weeks before the building was completed, it was filled by its legitimate occupants of the *Order Ratitae*—ostriches, emeus, rheas, and cassowaries—and a miscellaneous assortment of large land birds which had been crowded out of the Aquatic Birds' House, and sorely needed comfortable shelter. The arrival of three delicate but very valuable deer from Paraguay made it necessary, for the preservation of their lives, to quarter them in the best place to be found for them, which proved to be in two of the Ostrich House cages,—where their lives were saved.

A full description of the Ostrich House appeared in our Bulletin No. 16. Thus far this building has proven a most gratifying success. Although as light as the outside world, it is easily kept warm and comfortable, and its living inhabitants appear to enjoy life uncommonly well. The series of cages with high floors display their contents better than those which are on a lower level. A fine series of descriptive labels, a chart of the *Order Ratitae* and several large drawings of allied fossil birds, all prepared by

CALIFORNIA CONDOR.

Curator C. William Beebe, add an element of popular interest and value to this collection.

The Ostrich House contained, on December 31st, 2 South African ostriches, 2 North African ostriches, 2 common rheas, 1 great-billed rhea, 3 emeus, 1 Ceram cassowary and 1 violet-necked cassowary. As rapidly as the other birds not properly belonging in that building are withdrawn, other species and specimens of struthious birds will be added. The entire collection for this building is the gift of Mr. Charles T. Barney, Chairman of the Executive Committee of the Zoological Society.

The completion of the Large Bird House, by June 1, 1905, will add to the Park a bird collection of great importance. This building is to contain not only the song birds generally, but also the parrots, macaws and their allies, the shore birds, toucans and hornbills, woodpeckers, and many large and important land birds of the tropics, such as the curassows, guans, spur-winged turkey, secretary bird and seriama.

In order to reduce the cost of furnishing live fish to certain

species of fish-eating birds, the pond in the Moose Range has been well stocked with breeding carp, kindly supplied by the director of the New York Aquarium, and it is expected that many thousand young carp can be bred annually for food purposes. This will make it possible to keep a certain number of diving birds which until now could not be adequately supplied with live fish. In addition to the stocking of this pond with carp, a great number of yellow perch fry and young goldfish were placed in the Aquatic Mammals' Pond and Cope Lake.

The composition of the bird collections on December 31, 1904, was as follows:

Order.	Species.	Specimens.
Ratitae	6	10
Longipennes	6	32
Steganopodes	7	24
Anseres	22	221
Odontoglossae	1	1
Herodiones	15	53
Paludicolae	8	12
Limicolae	1	1
Gallinae	18	74
Columbae	3	3
Accipitres	12	30
Striges	9	25
Psittaci	23	35
Passeres	34	122
14 Orders	165	643

During the year several experiments of a very interesting nature were carried out by Curator Beebe. Complete success was attained in the rearing and keeping of the common tern and sooty tern, black skimmer, honey creeper, and three species of bitterns,—the latter the most difficult of all herons to establish in captivity. A large colony of laughing gulls was successfully established beside the pool in the old Caribou Range. After spending two years in the Park, several of these birds migrated southward in the autumn of 1903, and returned to the Park colony in the following spring. A beautiful flock of 30 brant geese was placed on the Mammal Pond, where they attract much attention.

The sandhill cranes in the old Caribou Range nested and laid fertile eggs, but failed to hatch them. The snowy herons nested

in the Flying Cage, but on account of the interference of the cormorants, failed to lay eggs. Among the birds of particular interest and rarity now living in the Park are the spectacle owl, tiger bittern, willow ptarmigan, little brown crane, banded curassow, Patagonian lapwing plover, great white heron and Indian adjutant.

In the Aquatic Birds' House has been placed a large upright wall case, of copper and glass, in which is now being arranged

LLAMA AND YOUNG BORN IN THE PARK.

a collection to illustrate the anatomy of birds of the more important orders, with a carefully selected assortment of eggs and nests of special interest to visitors. Upon the wall of that building has been hung a large and handsome oil-color reproduction of the Director's "Landscape Chart of the Orders of North American Birds."

DEPARTMENT OF REPTILES.

At the close of the year 1904, the Reptile House contained the best assortment of reptiles which we have yet exhibited. The collection of serpents is especially rich in poisonous species, and includes the most celebrated types of the world. The recent accessions include the Egyptian cobra, or "asp," the rare but remarkable bushmaster of Trinidad and South America, and a gray rattlesnake from Central America which is new to science, and is elsewhere described in this volume.

During the past year Curator Raymond L. Ditmars has rearranged the reptile collection, and undertaken to provide it with the descriptive labels that have long been contemplated. It is believed that through a more comprehensive system of labeling, the reptile collections may be made more useful to teachers and students. In making these improvements, the numerous queries of visitors have been noted as points needing explanation in descriptive labels of particularly interesting species, or groups. To this end, maps have been prepared by the curator, showing in colors the distribution of families, genera and species of the poisonous serpents of the world, and certain large lizards. Accompanying these is printed matter, explaining the habits and interesting physical characteristics of the reptiles in question. Two large charts, illustrating the classification of poisonous serpents, have also been prepared, framed and placed in a prominent position. These attract much attention from visitors; and additional charts of a similar character are now in course of preparation.

During the past year the most important foreign accessions consisted of a fine pair of rhinoceros iguanas, two South American tegus, five specimens of the rough-eyed caiman, a Galapagos Island tortoise which came as a gift from Major W. de S. Maud, a reticulated python and two boa constrictors.

During the summer Messrs. Adam Dove, Morris Pearsall and Curator Ditmars spent several weeks in Sullivan County, collecting local serpents. The total catch amounted to 273 specimens, representing 10 species, and the entire collection was presented to the Zoological Society. In this fine lot were 44 specimens of the banded rattlesnake.

In the Reptile House there were in 1904 no death losses worthy of note, and the state of the reptile collection as a whole is highly creditable to those responsible for it. On December 31st, a count of the living specimens on hand gave the following summary:

LIVING REPTILES AND AMPHIBIANS.

	Species.	Specimens.
Chelonians (Tortoises, Terrapins and Turtles).	31	125
Crocodilians (Crocodiles and Alligators)	3	43
Lacertilians (Lizards and Iguanas)	23	122
Ophidians (Serpents)	50	282
Amphibians	10	71
	117	643

A summary of the Zoological Park collections as they stood on December 31, 1904, is as follows:

Mammals	154	Species.	516	Specimens.
Birds	165	"	643	"
Reptiles	107	"	572	"
Amphibians	10	"	71	"
	436	"	1,802	"

ADMINISTRATION.

The most important new development of the year in this department was the Riding-Animal establishment. Early in the year, Chief Clerk H. Raymond Mitchell purchased an outfit of ponies, carts, harnesses and saddles, and engaged a force consisting of one man and three boys to handle the riding and driving animals. It was finally decided to use the extreme northern end of the Motor Road as a riding-animal concourse, and accordingly a stand was established by paving, draining and railing-off a suitable area of ground under the large oak trees opposite the new Bird House.

The arrival, in July, of a fine half-grown tusk elephant from Assam, the gift of Col. Oliver H. Payne, greatly increased the interest of visitors in the riding animals, but the untrained condition of the animal, and the preparation of a suitable elephant-saddle, occasioned some delay in the elephant service. The animal was placed in the hands of Keeper Frank Gleason, who from the very first has handled "Gunda" with excellent judgment and success. Within three weeks from his arrival at the Park, the

elephant was carrying visitors, and unquestionably took quite a commendable degree of interest in his work. During his rather brief working season, Gunda carried 2,635 visitors, whose tickets yielded a total return of $395.25.

For months past the director of the Park has been searching for two Siberian double-humped camels which were fine enough to meet all requirements. About 50 camels were inspected and rejected, and during the year 1904 none of a satisfactory character could be found for sale. At last, in February, 1905, in a particularly good lot of camels imported by Mr. Louis Ruhe, two very fine animals were found and immediately purchased. It is intended that one of these shall do duty as a riding animal, and the other will remain at the Camel House (to be erected early in 1905) as an exhibit.

The net profits on riding animals for the brief season of 1904, with only a partial outfit of animals, was $766.52, all of which has been paid over into the "Animal Fund."

Restaurant, Etc.—The patronage of the Rocking-Stone Restaurant has increased in a satisfactory degree. Instead of a deficit, the year's business resulted in a net profit of $863.24, a portion of which, however, was necessarily reserved for the payment of the usual loss on the winter's operations.

Owing to an unusually cool summer, the year's receipts from the soda pavilions and candy stands were not so great as in 1903. The total net revenue from these sources amounted to $2,867.33.

Telephones.—As fast as new buildings are constructed and occupied, each is provided with a telephone. It was found necessary also to establish telephone communication with the various soda pavilions, and this was done. A very satisfactory contract for the maintenance of the Park local telephones was made with Mr. George F. Archer, and on the whole the local service has been excellent.

Storage Barn.—The present system of buying hay, straw and grain in comparatively small quantities, because large quantities can not be stored, is not economical, nor always fruitful of the best results in the quality of food. It was therefore decided that a large barn should be built, at the earliest possible moment. Plans for this improvement have been prepared by Mr. Beerbower, and a first-class barn building will very shortly be erected. It will be situated on the site of the old store-house, about one hundred feet east of the present Service Yard. Along with it, new workshops will be built for the iron-workers generally, and

SERVAL

power will be provided for general purposes, both in the shops and the barn. The plant which will thus be secured will represent a considerable saving in certain annual maintenance charges, as well as an improvement in the quality of hay and grain.

CIVIL ENGINEERING DEPARTMENT.

As usual Mr. George M. Beerbower, the Civil Engineer of the Zoological Park, has been throughout the year closely occupied in the multitude of tasks that only a staff engineer can perform. Aside from an unusually long list of routine services in connection with new walk construction, range fences, and the drainage and water supply of the Asiatic Deer installation, our

engineer's most important task during the year has consisted in laying out a new service yard, and preparing plans for the large Storage Barn and Iron-workers' Shops already mentioned.

Our engineer made a careful topographic survey of the unimproved area outside the Zoological Park boundary and adjacent to our Southwest Entrance. This was submitted to Park Commissioner Henry C. Schrader, with a request that the Park Department blast out certain quantities of exposed rock, and replace with top soil sufficient for the proper planting of that area with trees and shrubs.

During the year Mr. Beerbower performed all the civil engineering work in connection with the improvement of Baird Court, and the building of the system of conduits for the electric-light cables and telephone-wires.

DEPARTMENT OF PHOTOGRAPHY AND PUBLICATIONS.

The work of Mr. E. R. Sanborn constantly increases, both in volume and in value. In the photographing of Park mammals, birds and reptiles, his work during 1904 has surpassed that of any previous year, and his collection of animal photographs has become one of the Society's valuable scientific possessions. These pictures are of constant use in promoting public appreciation of the Society, and its work in gathering and exhibiting animals. An important series of illustrations of Zoological Park animals will soon be published, if possible during 1905, in a volume now in preparation by the director, for the special benefit of the members of the Zoological Society.

The time has now arrived when our photographer must be supplied with a room and equipment for the printing and toning of photographs, and a helper to assist in this line of work. It is no longer desirable to have all our photographic prints made at a distance of nine miles or more from our photographer's negative-room, with all the delays, breakages and losses that now are involved.

GROUND IMPROVEMENTS.

For 1904 the list of tasks accomplished under this head is a very long one, and it is possible to refer to the various items only in the briefest manner. As heretofore, the Commissioner of

Parks aided the Society by consenting that the particularly difficult tasks in road-making, fence-building, paving and other minor construction should be performed under the personal direction of the officers of the Zoological Park. It was chiefly due to this arrangement that so great a number of tasks were undertaken and completed both economically and satisfactorily in the working season of 1904.

The Ostrich House.—Under a contract awarded and superintended by the Park Department, the George L. Walker Company erected, at a total cost of $36,890.00, a building 150 feet long by 29 feet wide in its interior, for ostriches, rheas, emeus and cassowaries. This structure was opened to the public on December 25, 1904. The exterior yards for this installation, eight in number, have been graded, drained, paved and fenced, wholly under the direction of the Society's Chief Constructor, Mr. H. W. Merkel, quite apart from the contract for the erection of the building.

The Small-Mammal House.—For the accommodation of the small fur-bearing animals and many other small species not provided for elsewhere, a building of the same size as the Ostrich House was erected under the same contract, and at the same cost. It is connected with its twin structure by a handsome and spacious portico. It represents the very latest improvements and methods in the care of small mammals of all kinds except monkeys, and it brought its living contents through the very severe winter of 1904-5 very successfully. It is provided with 176 cages, and constitutes a very important addition to the exhibition equipment of the Zoological Park.

Large Bird House.—The construction of this large and important building, also under contract with the George L. Walker Company, began early in 1904, and progressed favorably throughout the year. The contract price is $115,644.00, not including the glass addition in the southeastern angle. This structure is intended for perching birds generally, the parrots, macaws and cockatoos, the shore birds, guans, curassows, toucans, hornbills and woodpeckers. The completion of the main structure is expected in May, 1905.

The Pheasants' Aviary.—In October a contract for the erection of an aviary for pheasants, doves and pigeons, was awarded to Mr. Conrad Hewett, in the sum of $19,546. The old aviary was immediately removed, and work began very promptly upon the new structure. The new aviary is 240 feet long and provides 38 runways of various sizes. The upper story of the shelter house

is to be devoted to pigeons and doves. This installation is situated on the west side of the Aquatic Mammals' Pond, and occupies the site of the old aviary.

GROUND IMPROVEMENT WORK UNDER THE DIRECTION OF ZOOLOGICAL PARK OFFICERS.

During the year 1904 the Ground-Improvement force, working under the direction of Mr. Herman W. Merkel, Chief Constructor, has been larger than ever before, and its work has been not only of great importance, but also very satisfactory, from every point of view. The principal items will be briefly mentioned.

Baird Court.—During the year a great amount of labor and materials was expended on the southern half of Baird Court. An elaborate system of drainage was laid, underground conduits were constructed to convey electric-light cables and telephone wires to all the buildings of Baird Court, and the entire surface was filled, graded and paved. The portions to be used as walks were covered with telford macadam, and after a series of careful experiments were finished with a tarred surface. The eastern wall was built up in conformity with the final plan of Baird Court, and much of the new area thus enclosed was filled in. The shade trees will be planted in the spring of 1905.

Burrowing Rodents' Quarters.—The rusting of the wire of the Burrowing Rodents' Quarters necessitated a new covering, and advantage was taken of that occasion to lay concrete floors in all the cages, to make them entirely rat-proof. The rock-work was reconstructed on an improved plan, and, on the whole, the installation is now more perfect and attractive than heretofore. It is believed that the plague of rats which once afflicted this collection is now permanently abated. With the beginning of spring, this entire series of cages will be stocked with a new collection.

Electric Conduits.—The construction of a system of electric conduits, with which to carry electric-light cables to the buildings of Baird Court and Audubon Court, was an important item of construction. All this work was performed under the direction of Mr. Merkel, in accordance with the plans and specifications of Mr. James Robert Moore, Electrical Engineer, and it is believed that this important improvement is on a permanent basis. The total number of lineal feet of three-inch vitrified conduit constructed during the year was 3,800.

Rebuilding of Walks.—In the year 1899, when the total fund

available for the construction of walks, sewers, water-lines and roads was only $125,000.00, it was necessary that some of the work done should be on a much cheaper basis than was desirable. The walks constructed in that year cost only twelve cents per square foot, and therefore they were not of a permanent character. There being no money available with which to properly under-drain them, nor for the laying of first-class telford macadam, these walks were found, in early winter and early spring, to be seriously affected by alternations of freezing and thawing, and often became muddy on the surface. The Board of Estimate having granted funds for the reconstruction of these walks, the materials in them were removed, utilized in various ways elsewhere, and the old walks were entirely rebuilt of twelve-inch telford macadam, thoroughly under-drained, and provided with catch-basins.

New Walks.—In addition to the reconstruction of old walks, quite an amount of work was done in the construction of new walks, particularly around the Small-Mammal and Ostrich Houses. A new line was constructed leading from the Antelope House north on the axial line of that building, to connect with the two new buildings, and make their open-air yards accessible to visitors. A fine concrete approach, 18 feet wide, was constructed from the Sea Lion Pool to the Bear Dens. This was made necessary by the very steep grade of the hill, which renders it impossible to maintain a satisfactory walk of telford macadam. A concrete walk 14 feet wide was constructed in front of the Reptile House, leading from the Sea Lion Pool to the Wild Turkeys' Enclosure.

Asiatic Deer Barn and Ranges.—On a prominent elevation immediately west of the Aquatic Birds' House, there was erected during the year a spacious and well-appointed shelter barn, designed to accommodate a collection representing the species of Asiatic deer. This building was completed and occupied in October, and it is believed that it may well be taken as a model structure for such collections as it will accommodate. It is now completely filled, and contains eight species of deer.

Harriman Alaskan House and Totem Pole.—At the expense of Mr. Edward H. Harriman, the very fine Totem Pole and House originally constructed by the Tlinkit Indians at Cape Fox, Alaska, and in 1899 brought to the Zoological Park as Mr. Harriman's gift, was erected between the north end of the Aquatic Mammals' Pond and the Wild Turkeys' Enclosure. These two objects together form a very striking and instructive

exhibit, and constitute a valuable addition to the educational equipment of the Zoological Park.

Cleaning the Bronx River.—The extensive grading and filling operations necessary in the Zoological Park grounds east of the Bronx River and south of Pelham Parkway, afforded an opportunity to remove from Lake Agassiz a great quantity of earth for use as filling material. This opportunity was improved to the fullest extent possible, and about three feet was taken off the surface of the mud flat in Lake Agassiz throughout about half of its entire area. It is our intention to remove still more of the alluvial deposit of Lake Agassiz during the present year, for use as filling material in the north end of Baird Court. If the deepening of the whole shallow area of Lake Agassiz can thus be accomplished, it will be a great advantage to that body of water.

Among the smaller tasks of our Ground-Improvement force, under Mr. Merkel, the following are worthy of brief mention:

A log-cabin shelter-house, of rustic spruce, was erected in the Mouflon Range of Mountain Sheep Hill; and from five areas on Mountain Sheep Hill, sod was removed, and steam ashes put in its place.

An extension for the Chief Clerk's office was added to the Service Building.

A shelter-house for the steam roller was built in the service yard.

A section of the old Pheasant Aviary, 40 feet long, was moved to the service yard, and fitted up as a room for the use of the Park workmen during the noon hour.

Another 40-foot section of the same building was also moved into the service yard, and fitted up as a work-shop for our force of wire-workers.

A temporary but very comfortable shelter-shed, 80 feet long, was built south from the Buffalo House, as additional shelter for the Whitney buffalo herd. This was of great value during the severe winter which followed.

An iron tower, an elevated water tank and a gasoline engine were provided for the Nursery to place its water supply on a proper basis, and save costly pumping by hand.

The Buffalo and Elk Ranges were ploughed twice during the year, to kill the poisonous grasses.

A really great amount of labor was expended in the preparation of the ground and fences for a series of 8 large yards connecting with the indoor cages of the Ostrich House. The fencing

was made wholly by the Park force of wire-workers, and the result of this experiment has proven to be highly satisfactory.

Guard wires to a total length of 8,160 feet were constructed along the paths and roads, of coiled-steel wire on wrought-iron posts.

A special breeding cage for song birds was constructed on the rocky hill near the Aquatic Birds' House.

Two brick vaults for electric-light converters were constructed in the Lion House and Ostrich House.

The three large outside cages at the Lion House received, from the hand of Carl Rungius, the noted animal painter, the landscape backgrounds above and behind their rustic rockwork, according to the original scheme. The result has been cordially approved by the Executive Committee and the public.

Maintenance Work.—The entire Flying Cage was scraped free from rust, repaired and thoroughly painted. Among other installations similarly treated are the following:

Ducks' Aviary Fence.	Wolf and Fox Dens.
Raccoon Tree.	Fence around Mammal Pond.
Prairie-Dog Fence.	Beaver Pond Fence.
Fence at Sea-Lion Pool.	Fence at Crocodile Pool.
Eagles' and Owls' Cages.	Eastern Boundary Fence.

All of the entrance pavilions were scraped and varnished, and the service buildings and shops repainted.

Upon the force of maintenance laborers, under Mr. E. H. Costain, fell the work of maintaining cleanliness and order around buildings; supplying bedding, food and ice to the various buildings; keeping the pools and ponds free from ice; removing the snow from the yards and walks; removing refuse; mowing the lawns; protecting the trees; maintaining and heating the buildings; repairing cage work and fences; caring for the ornamental plants in the various buildings and throughout the grounds; raising supplies of vegetables and animal food; harvesting the ice and looking after the hundreds of catch basins, miles of sewer and water pipes, and many other details. Naturally this burden of maintenance details grows heavier with the growth of the Zoological Park as a whole. Mr. Costain is entitled to much credit for his handling of this work.

Planting.—The entire boundary plantation was supplemented by the planting of low-growing trees and native shrubs. Exten-

sive planting was done at the Antelope House, after all of the surrounding area had been graded, top-soiled and seeded. This same process was carried out wherever grades were changed along new or reconstructed walks.

Two beds of rhododendrons, azaleas and flowering plants, later on replaced by evergreens, were planted at the Pelham Avenue and Southwest Entrances. Three carloads of native rhododendrons, and thousands of other shrubs, such as azaleas and plants of like character, were used along Beaver Valley Walk. This, however, was but the beginning of the ornamentation of this walk, the sides of which, on account of the varying condition of soil, light, shade and moisture, admirably adapt themselves to this purpose.

PROGRAM FOR 1905.

For the coming year, the program of improvement work is fully as lengthy and important as that for 1904. The most important undertakings now before the Zoological Society for the immediate future are the following:

The completion of Baird Court by the construction of suitable retaining walls, steps and balustrades, and the filling, draining and surfacing of the northern half of that area;

The construction of the Concourse, leading from the Pelham Avenue carriage-entrance to the north end of Baird Court;

The construction of a rock shelter in the Sea-Lion Pool;

The erection of a Boat-House and a Public Comfort Station near the West Farms Entrance, and a Public Comfort Station on the eastern side of the Bronx River, near the dam;

The construction of a walk leading from the Northeast Entrance, at the Boston Road bridge, to Baird Court;

The erection of a house for camels near the Southwest Entrance;

The erection of a house for small tropical deer and antelopes;

The erection of a barn and permanent shop for iron-workers, in connection with the administrative plant;

The rebuilding of the walk in front of the Pheasants' Aviary, and along the western bank of the Aquatic Mammals' Pond;

The construction of an aviary for grouse;

The construction of additional Fox Dens, to complete the series as originally planned;

The construction of a walk leading from the Ostrich House yards directly to the entrance of the Reptile House;

The completion of the above will be followed as quickly as

possible by the erection of the Elephant House, and its complement of open-air yards and bathing pools.

For nearly all of the above improvements plans are well advanced toward completion, and will be submitted at an early date.

Respectfully submitted,

WILLIAM T. HORNADAY,
Director.

January 1, 1905.

SKIN OF INLAND WHITE BEAR *URSUS KERMODEI*.
No. 1. ♀ Type specimen.

A NEW WHITE BEAR, FROM BRITISH COLUMBIA.

By WILLIAM T. HORNADAY.

DURING the past twenty years, naturalists have been surprised by the discovery in northwestern America of new species of mammals so large and so conspicuous that it seemed strange they had so long remained unknown. The finding of the white mountain sheep, glacier bear, and several new forms of caribou and mountain sheep, have strongly emphasized the fact that the great Northwest contains many regions as yet wholly unexplored by naturalists and scientific sportsmen.

Indeed, it may truthfully be said that in northern British Columbia, Alaska and Yukon Territory, zoological explorations have only fairly begun. There are vast regions, containing we know not what new animal life, which have been practically untouched by the zoologist. Excepting the territory drained by the Stickine River and a few of its smaller tributaries, northern British Columbia is, to scientific collectors and students, a land almost unknown, and therefore it is an inviting field for exploration.

In November, 1900, while making an examination of the skins of North American bears that were to be found in Victoria, British Columbia, the writer found a very strange specimen in the possession of Mr. J. Boskowitz, a dealer in raw furs. The skin was of a creamy-white color, and very small. Mr. Boskowitz reported that it had come to him from the Nass River country, and that he had previously received four or five similar skins from the same locality.

Although this skin was of small size, and had been worn by an animal no larger than a grizzly cub one year old, its well-worn teeth indicated a fully adult animal. Believing that the specimen might really represent a new ursine form, it was purchased, and held for corroborative evidence. In view of the multiplicity of new species and sub-species of North American bears that have been brought out during the past ten years, it

is not desirable to add to the grand total without the best of reasons for doing so.

Four years have elapsed without the appearance of a zoological collector in the region drained by the Nass and Skeena rivers, and further evidence regarding the white bear of British Columbia was slow in coming. At last, however, the efforts of Mr. Francis Kermode, Curator of the Provincial Museum at Victoria, have been crowned with success, in the form of three skins in a good state of preservation. They represent two localities about 40 miles apart. The four specimens now in hand are supplemented by the statements of reliable persons regarding other white bear skins which have been handled or seen by them, and were known to have come from the same region.

Following the route that a polar bear would naturally be obliged to travel from its most southern haunt in Bering Sea to the Nass River, the distance is about 2,300 miles. But the teeth of these specimens show unmistakably that they are not polar bears.

There is not the slightest probability that albinism is rampant among any of the known species of bears of North America; and it is safe to assume that these specimens do not owe their color to a continuous series of freaks of nature. There is no escape from the conclusion that a hitherto unknown species of white bear, of very small size, inhabits the west-central portion of British Columbia, and that it is represented by the four specimens now in hand. In recognition of his successful efforts in securing three of these specimens, the new species is named in honor of Mr. Francis Kermode.

URSUS KERMODEI, sp. nov.

INLAND WHITE BEAR.

Type (No. 1), a flat skin, owned by the Provincial Museum, Victoria, of an adult female; teeth and claws present, but without cranium. Locality, Gribble Island, western British Columbia, Lat. 53° 25′, Lon. 129° W.

Other Specimens.—No. 2, a flat tanned skin of a very old specimen, purchased in Victoria, and locality given as "the Nass River." Nos. 3 and 4 are the filled-out skins of two cubs, about the size of black bear cubs six months old. They were obtained on the Kitimat Arm of Douglas Channel, about 75 miles inland from the western shore of Banks Island, British Columbia, and belong to the Provincial Museum, Victoria.

Description of the Species.—This is a bear of small size, much below the dimensions and weight of the average black bear (*Ursus americanus*). In general appearance its skin is like that of a long-furred and particularly handsome polar bear. Its color is clear, creamy white, with no trace of brown, black, or any other dark color. In the type specimen, on the upper neck and head, and on the forelegs, the yellowish creamy tint is well defined. The hair is all white, down to the roots; and on the entire animal there is not one brown or black hair.

The ears are very small, and the hair upon them is short and rather straight.

The pelage of the type specimen is very long, fine, abundant, and in places of silky softness. The hair grows in tufts, and both in quality and manner of growth it distinctly resembles the pelage of the Alaskan brown bears, rather than the shorter, smoothly-trimmed coat of the black bear. The basal half of the pelage is very fine, woolly and warm, and only the tip of the terminal portion is straightened out to form the rain-coat. Only on the forehead, muzzle and lower portions of the limbs does the hair grow short, and develop the straight and stiff character that is necessary, at those points, for the comfort of the animal. The pelage on the two young specimens consists of a dense coat of fine, woolly hair, through which appears a scattering growth of long, straight hairs. Both these skins are everywhere creamy white.

The claws are dull white, thin, and strongly curved, representing about 120° of a perfect circle, 1⅞ inches in diameter for the middle front claw.

The teeth differ widely from those of the polar bear, and indicate relationship to the American black bear, (*Ursus americanus*).

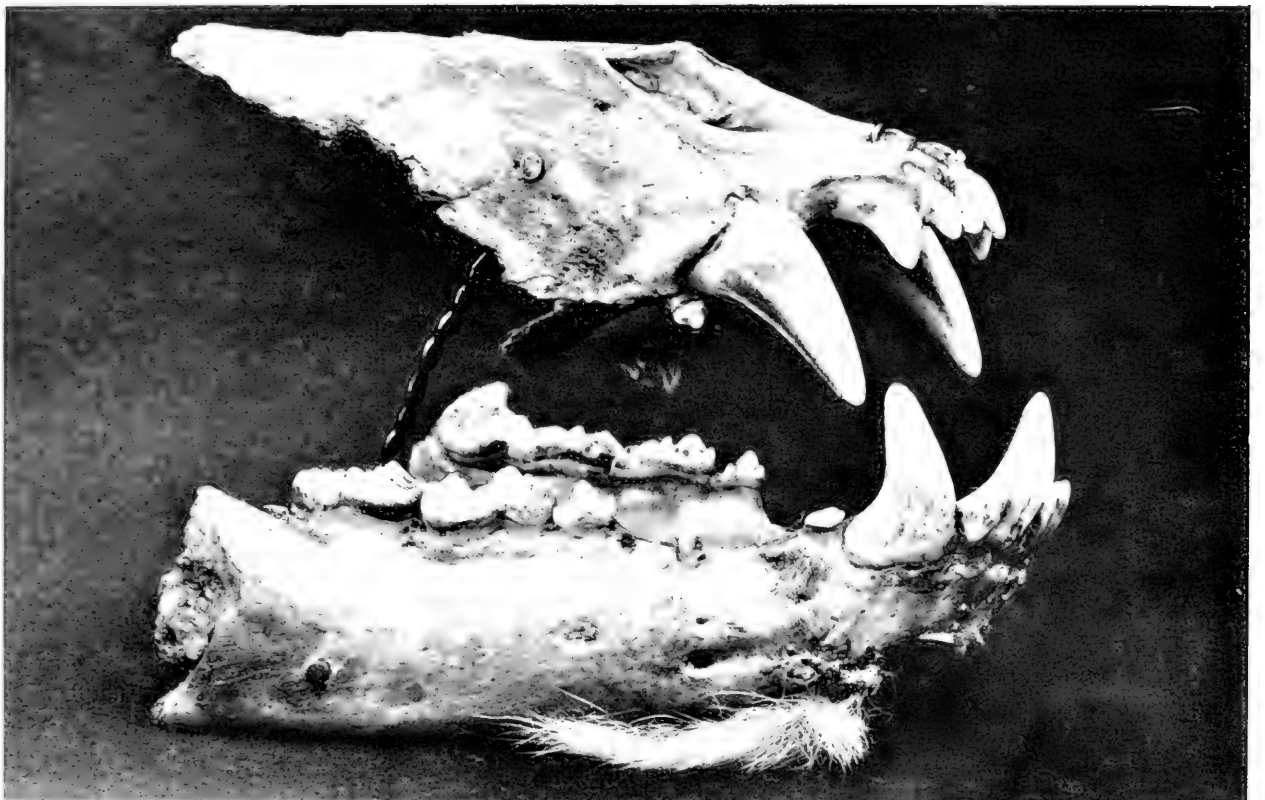
The dental formula is as follows:

$$\text{Incisors } \frac{3-3}{3-3};\ \text{Canines } \frac{1-1}{1-1};\ \text{Premolars } \frac{3-3}{3-3};\ \text{Molars } \frac{3-3}{3-3}$$

MEASUREMENTS.

No. 1.—Type specimen. Flat skin of an adult female.

Length of skin, end of nose to root of tail	54.50	in.
Length across forelegs, base to base of claws	46.50	"
Width of skin across middle of body	24.00	"
Height of ear	3.00	"



TEETH OF INLAND WHITE BEAR.

From Type specimen — Natural Size.

Length of hair on occiput	3.00 in.
Length of hair on shoulders	4.50 "
Length of hair on top of back	5.00 "
Length of hair on top of hind quarters	4.50 "
Length of hair on median line of abdomen	4.00 "
Length of hair in middle of forehead	1.00 "
Length of exposed portion of middle front claw, following curve	1.75 "
Length of rear middle claw, following curve	1.00 "
Length of molar tooth-row, including large premolar	2.25 "
Length of upper incisor tooth-row	1.25 "
Canines, distance between points	1.70 "

Judging by bears that have been weighed and measured in the New York Zoological Park, this animal when alive must have been about 27 inches in shoulder height, and its weight was about 200 pounds.

No. 2.—Adult skin, probably of a male.

Length, end of nose to root of tail	41.00 in.
Length across front legs, base to base of claws, approximately	34.00 "
Height of ear	2.50 "
Length, middle front claw, on curve	1.50 "
Pelage on shoulders	3.00 "
On top of hind quarters	3.00 "

The teeth are much worn, indicating the approach of old age.

No. 3.—Filled-out skin of a cub, in first year.

Length, end of nose to base of tail	22.50 in.
Length of head, about	7.00 "
Length of hair on shoulders	1.50 "
Length of hair on middle of back	1.50 "
Length of hair on top of hind quarters	1.75 "
Length of hair on abdomen	1.75 "
Length of exposed portion of middle front claw, following curve	1.00 "
Length of middle hind claw, exposed portion, following curve	.62 "

A Mr. Cunningham, who is a reliable trader and storekeeper at Port Essington, at the mouth of the Skeena River, stated to Mr. Kermode that every year he gets some white bear skins, in trade, and that they have come to him "only from the district south of the Skeena River, and have been taken as far south as Rivers Inlet. The most of them, however, have come from Kitimat Arm, which is just north of Gribble Island, about Lat. 54 ."

The man who shot the type specimen (No. 1) has stated that he knows of 18 other white bears having been taken in the region which furnished the type.

Apparently, the only reasons why this interesting ursine form has so long remained unnoticed are that no scientific collector has visited its locality, and the skins that have been taken have drifted into the fur trade, and quickly disappeared. No doubt they have been universally regarded, outside of British Columbia, as skins of young polar bears.

MAIN HALL IN THE NEW YORK AQUARIUM.

Shewing small aquaria mounted on the coping of the central pool, and table aquaria for turtles, located between the pillars.

REPORT OF THE DIRECTOR

OF THE

AQUARIUM

TO THE BOARD OF MANAGERS.

THE improvement of the Aquarium building, under the auspices of the New York Zoological Society, made decided progress during the past year.

The construction of a large reservoir for pure sea-water, the enlargement of sky-lights generally, and the alteration of unsightly features of construction were all accomplished by means of an issue of $30,000 of bonds, granted by the city in 1903.

A further issue of $40,000 of bonds was made in 1904, for the construction of pipe galleries underneath the building, the installation of salt-water filters, a heating and ventilating system, and other improvements. The work on the first two features is well under way. When completed it will permit of the new reservoir being put into use, and also the renewal of all worn-out piping connected with the floor pool and heating system. All the piping of the floor pools and heaters was originally buried in the earth underneath the building, where repairs have been impossible. Prompt attention to this matter became imperative. The work of excavating under the building was also necessary on account of the fact that the earth under one of the floor pools had settled so that the foundation of the pool needed strengthening. All this work is being thoroughly done, so that in the future all the piping in the building will be accessible for repairs. A new iron and glass vestibule for the main entrance is under construction.

Numerous improvements in the building and its equipment have been continued from the maintenance fund. Among these may be mentioned additional painting, the placing of foot rails around all floor pools, affording children better views than have been possible heretofore; the construction of a photographic room, and an attic room for the care of palms and other ornamental plants. This room, well supplied with skylights, will serve also at times as a place for keeping turtles, which do not flourish in the exhibition tanks, where they are cut off from sunlight.

Eight additional aquarium tanks have been located on the main floor between the central series of pillars, which have furnished a good means of exhibiting the collection of turtles. A further increase of tank space was secured by placing eighteen small aquaria on the coping of the large central pool. These supply exhibition space for an attractive collection of marine invertebrates. Additional rockwork has been cemented into the large exhibition tanks, as backgrounds, and the work of labeling the collection has been continued. Special care has been exercised in the preparation of the labels, which are so complete as to render the use of a formal guide book unnecessary to the casual visitor.

A very recent improvement of great importance has been the illumination of all wall tanks, with electric lights. This has overcome, in large measure, the darkness of the building during the winter season. The reception room has been supplied with rugs, curtains and comfortable chairs, and a number of semi-circular seats have been fitted to the outer series of pillars on the main floor. The admirable colored plates of the fishes of Porto Rico and Hawaii, issued by the U. S. Fisheries Bureau, have been framed in groups and placed on exhibition, together with certain tabulated information on the fishing industries of the United States.

In the service galleries and elsewhere behind the scenes the work of improvement has been carried on almost continuously; alterations have been made to lessen the cost of operation, increase light, provide for reserve specimens, and utilize waste space. A valuable bronze pump has been added to the equipment of the new sea-water system.

The readiness of the Department of Parks and the Board of Estimate and Apportionment to approve the issue of bonds requested for the improvement of the Aquarium has been most gratifying.

ATTENDANCE.

The attendance for 1904 was 1,625,770, an increase over 1903 amounting to 77,870.

The average daily attendance during the year was 4,454.

The number of visitors present on Sundays during the summer months was very large, records of 11,000 to 14,000 being common. The building was open to the public two hours longer each day during the summer season, while the half-day closing on Thursday was discontinued early in the year.

HEAD OF THE MANATEE.

Showing the upper lip expanded in reaching for sea weed. The outer edges fold inward in seizing food.

The following table shows the attendance at the Aquarium in 1904 by months:

January	Total number visitors			62,482	Daily average		2,016
February ...	"	"	"	74,361	"	"	2,564
March	"	"	"	118,356	"	"	3,818
April	"	"	"	136,310	"	"	4,544
May	"	"	"	182,917	"	"	5,901
June	"	"	"	152,498	"	"	5,083
July	"	"	"	203,728	"	"	6,573
August	"	"	"	222,725	"	"	7,188
September ..	"	"	"	193,050	"	"	6,435
October	"	"	"	135,331	"	"	4,365
November ..	"	"	"	83,342	"	"	2,775
December ..	"	"	"	60,670	"	"	1,957
Total...	"	"	"	1,625,770	"	"	4,454

With the close of the year 1904 the Aquarium completes its eighth year. The total attendance for these eight years amounts to 13,270,589, giving an average for the entire period of 4,544 visitors a day.

Since the opening of the Aquarium, on December 10th, 1896, there have been no accidents either to visitors or to the building. The demeanor of the public, even when the building was uncomfortably crowded, has been entirely satisfactory to the management.

In respect to attendance the Aquarium continues to be far in the lead as compared with other public institutions.

Its remarkable record for visitors is shown by years in the following table:

1897	1,635,252
1898	1,689,471
1899	1,841,330
1900	1,585,584
1901	1,644,856
1902	1,700,453
1903	1,547,873
1904	1,625,770
Total	13,270,589
Average per day	4,544

* Includes twenty-one days of December, 1896.

ONE OF THE BALANCED AQUARIA.
Similar ones are being placed in some of the Public Schools of New York
Photograph by L. B. Spencer.

THE COLLECTIONS.

During the year the tanks of the Aquarium have contained larger collections than ever before. Profitable exchanges were made during the summer with the new Aquarium at Detroit, and the Government Aquarium at the St. Louis Exposition. A further collection of nearly 200 fishes, representing 37 species, was presented by the Bureau of Fisheries at the close of the Exposition, being transferred from St. Louis to New York in one of

FEEDING THE MANATEE.

Showing height to which head is raised in seizing food.

Photograph by W. L. Beasley.

the Government cars. It included species that have not been seen at the Aquarium for several years, notably the grayling, red snapper and spade-fish.

Four large sturgeons secured early in the summer, are in good condition at the present time.

The usual summer shipments of tropical fishes from the Bermuda Islands were received through the assistance of Professor Charles L. Bristol, of the University of the City of New York. The exhibit of brilliantly colored tropical species is always an attractive feature of the Aquarium.

An effort was made to secure specimens of the white-whale for the large central pool, and a bid to furnish them was accepted from parties on the St. Lawrence River. The season passed, however, without any being captured. This pool was then supplied with four sharks, each nine feet long, none of these animals surviving more than a few days, and it was stocked with small sand sharks, large drumfish, sturgeon and loggerhead turtles. Harbor seals were finally secured for one of the side pools.

Important specimens of game fishes were presented by the Tuxedo Club and the Southside Sportsmans Club. A large specimen of the hawksbill turtle was presented by Capt. Wm. H. Blake.

Mosquito Exhibit.—During the summer and autumn a small aquarium was kept supplied with the larvae of mosquitoes, for the purpose of showing the hatching of mosquitoes in still water.

A label was provided stating the facts that mosquitoes breed only in stagnant water, and are the only known distributers of the germs of malaria and yellow fever. Attention was called to the danger caused by unprotected rain-barrels, cisterns and ponds, and the necessity of obliterating the breeding places of mosquitoes, in order to avoid the disease and annoyance caused by their bites. At all times when the building was open to the public this valuable object-lesson was being studied by interested visitors. As an exhibit of aquatic insect life, appropriate to a public aquarium, it was a decided success.

The American Mosquito Extermination Society held one session of its annual convention in the Aquarium lecture room, on December 15, 1904, for the purpose of viewing a special collection of living fishes useful as destroyers of mosquito larvae.

Aquatic Insects.—The small tank of mosquito larvae kept on exhibition during the summer, having proved of great interest to visitors, a display of water beetles, and other aquatic insects

VIEW IN THE NEW YORK AQUARIUM.

Showing the large pools and wall tanks of the main floor and balcony.

will be provided in the spring. These can readily be arranged in small aquaria placed at intervals on the coping of one of the floor pools.

Manatees.—The Manatee or sea-cow obtained in September, 1903, was lost five months later from pneumonia, when the building became cold through belated work on the skylights. Two more manatees, male and female, were procured in June, 1904. They were taken in Lake Worth, Florida. The young male died at the end of eight months. Many of its internal organs were infested with flat-worm parasites, some of which perforated the membranes of the brain and caused its death. The larger specimen, the female, was eight and one-half feet long when received. The manatee feeds freely on eel-grass (*Zostera*) and becomes very tame, raising the mouth from the water for food. When the local supply of eel-grass failed in January the manatee was fed on lettuce and celery tops. While the male lived the pair kept close together both when active and at rest.

During the first three months of her captivity the large female turned on her back each day when the water was drawn from the pool. This practice has been abandoned entirely, the animal now rests belly down, in the empty pool, with the front end of the broad nose applied close to the floor. In water manatees rise to breathe at intervals varying from five to eight minutes, and do not increase the number of respirations when out of water. When stranded they are comparatively helpless, making lateral movements only, and these with considerable effort.

The accompanying photographs show the utmost height to which the female has raised her head above water in reaching for food, even when hungry. The young male never raised his head so high above the surface. All three manatees followed the attendant around the pool at feeding time, swimming very slowly. Their movements were always deliberate.

Fish Hatchery.—The United States Fisheries Bureau supplied the Aquarium, during the winter, with fish-eggs from Government hatcheries. The hatchery was in operation throughout the fish hatching season, and the young fish derived from it were turned over to the New York Fish Commission for planting in State waters. The exhibit was of constant interest to visitors. It showed, in various stages of development, the eggs and young of the Atlantic, landlocked and quinnat salmon; the rainbow, brook, lake, and brown trouts, and the Lake Erie whitefish. Numerous specimens of all these species were retained at the Aquarium, for exhibition purposes, and there is now a good col-

lection of yearling and two-year-old specimens of most of these valuable food and game fishes.

A supply of trout and salmon eggs was furnished by the Bureau of Fisheries to the New York Sportsmen's Show, held in Madison Square Garden in February. These were exhibited in a small hatchery erected under the supervision of the director of the Aquarium. An employee of the Aquarium was detailed for duty at the Garden during the continuance of the Exhibition to insure their safety. The eggs were afterwards transferred to the Aquarium, where they were hatched out, and finally delivered to the New York Fish, Forest and Game Commission for distribution.

A number of persons interested in fish-culture made repeated visits to the fish-hatchery, among them Prof. I. Itani, Fishery Commissioner of Japan.

Before the close of the year arrangements were made with the United States Fisheries Bureau for the continuance of the fish-hatching exhibit during the season of 1905.

WORK OF THE COLLECTOR.

The collector, Mr. John J. DeNyse, has procured not only the supply of local marine specimens, but gathered great quantities of minnows and shrimps as live food. He has also gathered, at no small effort, large quantities of eel-grass, used as food for the manatees. One of his trips, extending as far as Lake Chautauqua, resulted in several large specimens of muskallunge. In procuring local fresh-water fishes he has had the assistance of other employees. The surplus of marine invertebrates, procured by the collector, has been supplied freely to teachers in the public schools.

SMALL AQUARIA IN THE PUBLIC SCHOOLS.

The New York Aquarium continues to assist teachers of biology in the schools, by furnishing from its surplus stock, specimens of marine invertebrates for school aquaria. No expense is incurred other than the time and carfare of the messenger delivering the specimens. The necessary aquaria jars are provided by the schools, and teachers visit the laboratory at the Aquarium, where instruction in caring for small aquaria is given by Mr. L. B. Spencer. The number of aquaria already stocked is about 180, and no specimens have been supplied except at the special request of the principal or teacher.

An increasing number of teachers from the public schools and other educational institutions have visited the Aquarium with their classes. They have had the freedom of the large laboratory on the second floor, where living corals, marine worms, and other delicate organisms afford opportunity for elementary instruction in natural history.

DENSITY OBSERVATIONS AT THE AQUARIUM.

Daily observations respecting the fluctuating density of the salt water used at the Aquarium were continued during the year. Reference has been made in previous reports to the fact that the sea fishes at the Aquarium have always been kept in brackish water. The accompanying table of monthly mean densities for the year, shows that the so-called salt-water averaged about half fresh from month to month. The daily records, however, show that during many weeks, from March to June, the water was fully three-quarters fresh. In fact, the daily observations of 1903 contain many consecutive records of density as low as 1.006:

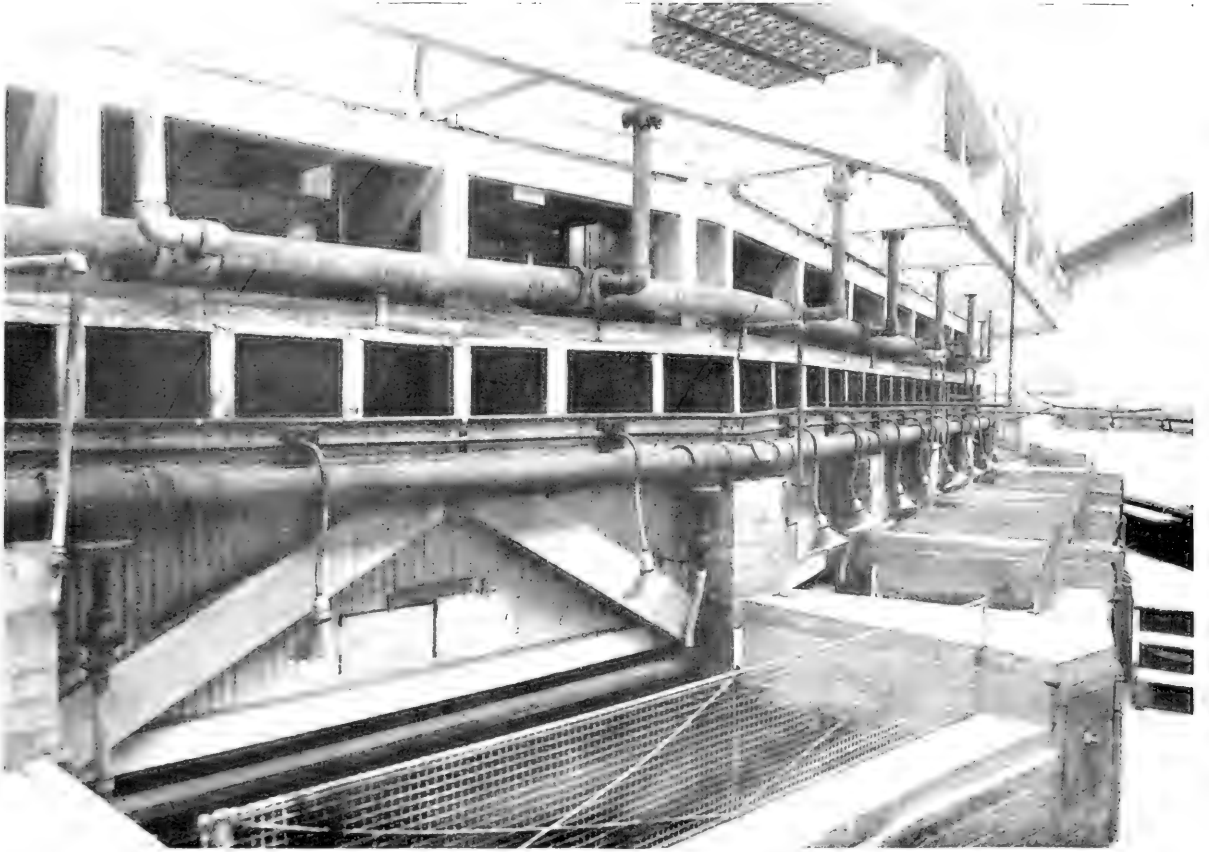
MONTHLY MEAN TEMPERATURES AND SPECIFIC GRAVITIES AT THE NEW YORK AQUARIUM DURING THE YEAR 1904.

(From the daily observations made by Mr. W. I. DeNyse.)*

Months.	Temperature of water.	Specific gravity.
January	34	1.014
February	33	1.014
March	36	1.013
April	40	1.009
May	52	1.010
June	61	1.010
July	70	1.013
August	71	1.014
September	68	1.014
October	59	1.013
November	51	1.013
December (for 26 days)	39	1.015

Most sea fishes cannot live long in water so nearly fresh as the above record shows it to be. If it were not for the fact

*Density observations were made with samples of water brought to a temperature of 60° Fahr.



SERVICE GALLERY IN THE NEW YORK AQUARIUM.

Showing the lower wall tanks, reserve tanks, piping and electric lamps

that a limited number of species do withstand it for considerable periods, the renewal of the supply of sea fishes would be necessary more frequently.

The completion of the work on filters, now in progress, will permit of the new reservoir for pure sea water being brought into use, when immediate relief from troubles due to brackish water may be expected. The long endurance, under these conditions, of the species named below is very interesting zoologically:

SEA FISHES FROM THE BERMUDA ISLANDS WHICH HAVE LIVED FOR LONG PERIODS AT THE NEW YORK AQUARIUM, IN WATER RANGING IN DENSITY FROM 1.016 DOWN TO 1.005.

Nassau grouper (*Epinephelus striatus*)	7 years.
Gray snapper (*Lutianus griseus*)	7 years.
Spot snapper (*Neomenis synagrus*)	6 years.
Squirrel-fish (*Holocentrus ascencionis*)	5 years.
Amber-fish (*Seriola lalandi*)	5 years.
Striped grunt (*Haemulon elegans*)	5 years.
Angel-fish (*Angelichthys ciliaris*)	5 years.
Trigger-fish (*Balistes carolinensis*)	5 years.
Surgeon-fish (*Teuthis hepatus*)	4 years.
Green moray (*Lycodontis funebris*)	4 years.
Common rockfish (*Mycteroperca bonaci*)	4 years.
Red hind (*Epinephelus guttatus*)	3 years.
Yellow-tail (*Ocyurus chrysurus*)	3 years.

STUDY OF FISH DISEASES.

Like all institutions of the kind, the Aquarium suffers losses of specimens from causes other than those attributable to a bad water supply. As diseases of several kinds are common, arrangements have been made recently for the pathological examination of all fishes dying in the Aquarium. All specimens lost, from any cause whatever, are now sent to a physiological laboratory for examination. The fishes are fully labeled as to name, locality, time kept in the Aquarium, and duration of disease. These data, together with subsequent notes by the pathologist on each specimen, will, it is believed, constitute a record of value to aquarists, and lead to more successful management of fishes in captivity.

GUIDE BOOK.

The preparation of a useful guide book is well advanced. Serious consideration is being given to this feature of the work of the Society, in order that it may be made a book of permanent value. It will contain not only an account of the collections in the building, but considerable information respecting the methods employed in operating a great aquarium; such, for instance, as its mechanical equipment, water supply, and the gathering and feeding of the collections. It will be illustrated with a fine series of original photographs from life.

The manuscript and illustrations of a work on The Invertebrates of the New York Coast were recently presented to the Society by Dr. Alfred G. Mayer, Director of the Marine Biological Station of the Carnegie Institution at the Dry Tortugas Islands, Florida. This work now in the hands of the printer, will be placed on sale at the Aquarium and elsewhere. All income derived from it is to be applied to the improvement of the Aquarium. Being a work based on the sea-shore life of the coast adjacent to New York, it will be not only a natural history of local invertebrates, but also a reference book admirably adapted for the use of those studying such forms of life in the Aquarium. It is the intention to place on exhibition, many species of invertebrates as soon as the improvement of the water supply can be effected. Dr. Mayer's book, and the guide book which will follow it, will constitute Nos. I and II of The New York Aquarium Nature Series, and other small publications on subjects pertinent to the work of a great aquarium will be issued later.

LIBRARY.

The small library attached to the director's office has received some very desirable additions during the year, both as gifts and by purchase. It is limited to works relating to fishes, fish-culture, the fishery industries, angling, marine mammals, reptiles, invertebrates, and aquatic life in general. Authors and scientific institutions have presented special papers on these subjects.* The library of works on angling and fish culture, formed by the late Nelson Cheney, being offered for sale, a number of very desirable books were secured.

The Smithsonian Institution and the United States Fisheries Bureau presented, as usual, their valuable annual publications.

*See list of gifts to the library.

The New York Forest, Fish and Game Commission presented a portfolio of colored plates of fishes and game animals of New York. Messrs. Julius Bien & Co. presented 119 colored plates of fishes of the Bermuda and Hawaiian islands.

The books of the Aquarium are frequently used by teachers, newspaper men, and nature students.

The great variety of species of vertebrates on exhibition at the Aquarium at various times during the year is deserving of special mention. More than two hundred and thirteen different species of fishes and other aquatic vertebrates have been shown alive. Of these, thirty-four species were turtles, salamanders, and crocodilians. The only mammals in the Aquarium are the manatee and the harbor seal.

These 213 species are carried in 100 wall tanks, seven floor pools and eight small aquaria. They are collected from a region extending from Maine to California, and from the Great Lakes to Florida and the Bermuda Islands.

The total number of specimens of vertebrates in the building on December 31, 1904, exclusive of young fry from the fish hatchery, and of all invertebrates, was 2,391.

A list of the species shown in 1904, at least 150 of which are almost constantly on exhibition, is published herewith in full.

Respectfully submitted,

CHARLES H. TOWNSEND, *Director.*

January 1, 1905.

FEEDING THE HARBOR SEALS.

NOTES ON CERTAIN PINNIPEDS,

WITH DATA RESPECTING THEIR PRESENT COMMERCIAL IMPORTANCE.

By C. H. TOWNSEND.

THE history of the world's seal fisheries is largely one of wasted resources. Very few sealing industries have been conducted according to methods calculated to perpetuate the race. From a commercial point of view, seals are the most important of the carnivorous animals. As a group they are probably also the most abundant of the larger wild mammals at the present time. It is doubtful if the herds of bison in America and of antelopes in Africa ever exceeded them in point of numbers. They are of world-wide distribution. Their pursuit has been carried on in the Antarctic as well as in the Arctic, but the sealing grounds of the Antarctic regions have long been exhausted commercially. Although the fur-seal fisheries of the North Pacific have received much international consideration during recent years, they are not the only seal fisheries of importance.

Newfoundland Seal.—The Newfoundland sealing industry is more than one hundred years old. It appears to have reached its height about forty years ago, when there were about 400 sailing vessels and 13,000 men employed. Since that time the catch of seals has decreased and has varied from year to year. The sailing vessels have been replaced by steamers whose numbers, at the present time, vary from twenty to twenty-five and employ from 3,000 to 4,000 men. The industry is based on the Greenland or harp seal (*Phoca groenlandica*), which has a very wide distribution and is probably the most abundant of any species of seal. A small number of hooded seals (*Cystophora cristata*) is included in the annual catch. It is taken upon the Arctic ice, from Newfoundland to Baffin Bay, and from Greenland across to the perpetual ice fields north of Europe. The greatest catch of seals made in one year was in 1844, when the number reached nearly 700,000. During the past six years the catch has varied from 268,881 to 353,276. The steamers employed are of considerable size, some of them of 500 tons burden. The seals are

taken on their breeding places on the drifting ice, where the crews land and kill the younger animals by clubbing. More than ninety per cent. of the catch is made up of young seals, taken before they are three weeks old, when they are large enough to enter the water. Owing to the fact that this species is taken upon the ice fields, and that the latter are at times greatly disturbed by storms, the catch of seals is subjected to certain natural limitations. After the more effective steamers had replaced sailing vessels it became necessary to place restrictions upon the slaughter of the animals. At the present time the season begins March 16 and the period during which seals are taken upon the ice lasts little longer than a month. The products utilized are the hides and oil, and the results of the industry from 1899 to date are as follows:

Year	1899,	Seals	268,881,	Net	Value	$342,378.
"	1900,	"	353,276,	"	"	483,601.
"	1901,	"	345,055,	"	"	388,895.
"	1902,	"	274,339,	"	"	402,623.
"	1903,	"	317,560,	"	"	449,797.
"	1904,	"	284,473,	"	"	403,794.

Southern Sea Elephant.—One of the practically exhausted seal fisheries is that based upon the sea-elephant or elephant seal (*Macrorhinus leoninus*), which once abounded on many of the islands off the southern portion of South America and on the Antarctic islands generally. Sea-elephants existed on their natural breeding grounds in great numbers, where they were killed for their oil, the skins having little value. No precautions were ever taken to preserve the race, and the species became scarce. The taking of the sea-elephant as an industry practically died out a number of years ago, which gave the scattered remnants of the race an opportunity to increase. The killing of sea-elephants in the Antarctic was revived about ten years ago at Ker-

Caspian Seal. Although seal fisheries are naturally associated with the great oceans, an important sealing industry is that of the Caspian Sea, which has long been carried on in this inland brackish lake. The seal which is the basis of this fishery (*Phoca caspica*), is a species peculiar to the locality, which probably found its way to its present habitat in very ancient times when the Caspian was connected with other seas. About thirty years ago the average annual seal catch in the Caspian Sea was slightly over 100,000, worth in skins and oil $350,000. There are no recent data at hand.

Lake Baikal Seal.—Another seal (*Phoca sibirica*), remarkable chiefly for its habitat, is that found in Lake Baikal in the heart of Siberia. Here, however, the range of seals is restricted to a body of water only 400 miles long, and their numbers are too small to be of more than local importance.

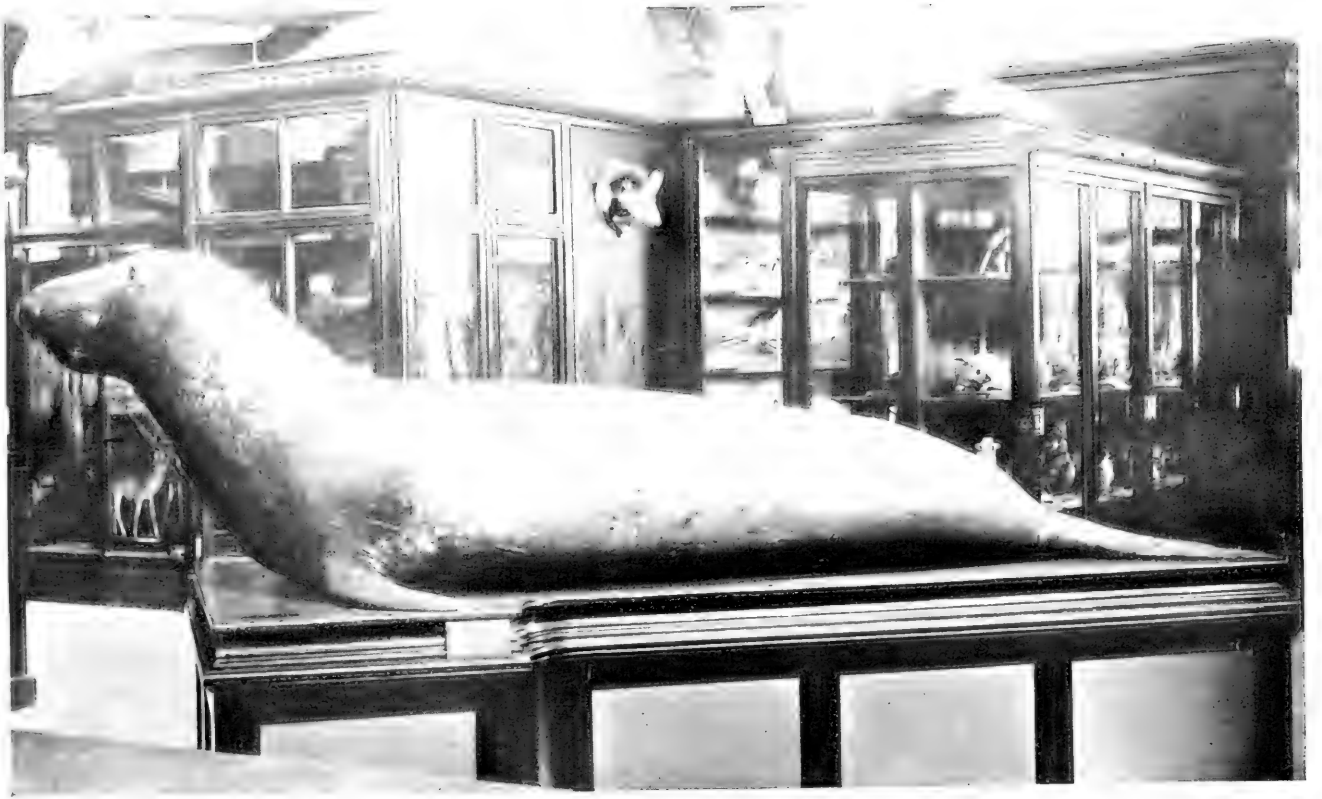
guelen Island by a vessel from New London, Conn. In 1897 a vessel from Boston visited Kerguelen Island and secured about 4,000 of the animals, which yielded 1,700 barrels of oil. A subsequent voyage was made to the same locality when the supply of seals was exhausted.

Northern Sea-Elephant.—An off-shoot of this species formerly existed along the coast of western North America from the islands of Southern California to the southern part of the peninsula of Lower California. It was for many years the basis of a sealing industry of no small importance, but was abandoned many years ago on account of the practical extermination of the species. In 1884 the writer visited Lower California in search of specimens of the sea-elephant for museum purposes. Although nearly the entire west coast of the peninsula was explored, only eighteen of the animals were found. In 1892 the writer visited Guadalupe Island, off the coast of Lower California, where six more specimens were secured. This species, known as *Macrorhinus angustirostris,* may be considered practically extinct, although a few stragglers were taken in 1904 by Capt. J. R. Mullett, of Monterey, California. The sea-elephant is the largest of the pinnipeds, old males sometimes exceeding a length of twenty feet.

Walrus.—The walrus (*Odobenus*), which is of circumpolar distribution, is another pinniped which has been exterminated in all of its more accessible resorts. It is now obtained only in its scattered hiding places in the Arctic. In 1899 there were important numbers in Bering Sea along the north shore of the Alaska peninsula, where the writer met with a vessel which had killed 1,600. The walrus is now seldom seen in that region. A century ago the walrus was sometimes found as far south as the St. Lawrence River in the Atlantic. Walrus ivory continues to reach the world's markets, but the supply in quantities of commercial importance can no longer be depended upon.

West-Indian Seal.—The West-Indian seal (*Monachus tropicalis*) was formerly abundant in the Caribbean Sea and the Gulf of Mexico, extending northeastward to the Florida Keys and the Bahama Islands. This species, valuable for its oil, was practically exterminated over one hundred years ago. A few individuals of the race still linger on the Triangle Islands in the Gulf of Campeachy, where occasional specimens are procured for museum purposes. A seal of this species lived five-and-a-half years in the New York Aquarium.

Antarctic Seals.—The various species of Antarctic fur seals (Genus *Arctocephalus*), were found about the southern shores



NORTHERN ELEPHANT SEAL, YOUNG MALE, PROBOSCIS UNDEVELOPED.

From a specimen in the National Museum, Washington, D. C

Collected by C. H. Townsend.

and islands of South Africa, Australia, New Zealand, and the islands of the Antarctic generally.

About the close of the eighteenth century a traffic sprang up in the skins of fur-seals, and as the result of the many voyages made to those distant regions enormous numbers of fur seals were taken. They exist to-day as mere remnants of the great herds that were once found in those regions. By 1830 the supply of fur seals in the southern seas was nearly exhausted. In this sealing no discrimination was made in the character of the seals taken; all animals whose skins were of any value were slaughtered, and the newly born young, usually left on the killing grounds, died in consequence. In the rush for seals to the Antarctic sealing grounds, the markets were frequently glutted and much of the catch wasted.

There are few parts of the world where seals of some species do not occur. All seals breed on land or on ice floes, and return, after their migrations, to their accustomed breeding places with great persistence. They can seldom be driven entirely away, stupidly lingering until brought near to the point of extermination. So certain are seals of returning to their breeding grounds, that the reestablishment of the different species soon follows the protection of these places. The safe-guarding of depleted sealing grounds would in fact be a good business proposition even at this late day, if they could be protected under the authority of the various governments laying claim to such lands.

South African Seal.—The South African fur seal (*Arctocephalus delalandi*), frequenting small islands off the west coast of South Africa, became very rare from indiscriminate sealing. It has, during very recent years, been protected by the Government of Cape Colony. The yield of skins from this source during the past three years has been as follows: 1902, 1,300; 1903, 4,800; 1904, 7,400. (Data from Alfred Fraser of New York.)

Galapagos Seal.—One resort of the genus *Arctocephalus*, the Galapagos Islands, lying on the equator, about 800 miles west of Ecuador, furnishes a striking illustration of wasteful sealing: Fur seals (*Arctocephalus philippi*) were taken from the Galapagos Islands in important numbers by early voyagers. Between 1870 and 1882 these rookeries were again visited by sealers, and, as far as the meager records collected from the sealers still living who engaged in this fishery show, about 20,000 seals were taken. This is, of course, a trivial number as compared with the total catch made during that period, the records of which are not available. The later voyages to the Galapagos Islands resulted

in the killing of all the seals that could be found. At the time of my first visit to the Galapagos Islands, in 1888, I was informed that there were only a few seals remaining about the uninhabited westerly islands of the archipelago. It was a matter of great surprise when in 1897 and 1898 a vessel returned to San Francisco from the Galapagos Islands with a catch of several hundred fur seals. It appears that the few that had escaped the slaughter of the last voyage, fifteen years before, had established themselves on the identical rookeries from which they had been driven, as comparisons of the log books of the vessels showed. The nucleus of a fine herd existed there, unknown to any one. There is no doubt that it could have been developed into an important seal fishery, if the fact had been known in time to prevent its destruction by raiders. It is probable that a few individuals have escaped this last slaughter, and that by the prompt protection of the rookeries by the Government of Ecuador, a fishery could be established.

Guadeloupe Seal.—Another species of fur seal (*Arctocephalus townsendi*), the most northerly off-shoot of the Antarctic race of fur seals, formerly inhabited Guadeloupe and other islands off the west coast of Lower California. From the scattered records that have been found, it appears that 15,000 seals have been taken there within comparatively recent years—the earlier records are not available. During the writer's visit to Guadeloupe Island, in 1892, straggling fur seals were observed about the island, and specimens obtained which proved the species to be new to science. It is possible that there is a sufficient remnant to warrant the belief that the race could be reestablished if the islands were properly protected by the Government of Mexico. The value of fur-seal skins taken in tropical or semi-tropical localities is small as compared with those from cold climates.

Lobos Seal.—In all the history of Antarctic sealing there is but one chapter of wise management and thought for the future: The Government of Uruguay has, throughout all these years, carefully preserved the fur seal rookeries of Lobos Island, at the mouth of the La Plata River, inhabited by *Arctocephalus australis*. These small rookeries illustrate the good resulting from the careful protection of fur seals upon their breeding grounds. Commercial sealing was carried on at Lobos Island prior to 1820. The lessees of the island, operating under the direction of the Government of Uruguay, placed upon the London market, from 1873 to 1904, 377,033 skins, or an average of over 13,000 a year, worth in 1901, $100,000. All these were derived from a single

island less than one mile in length. The following data show the yield of skins from Lobos Island during the past three years: 1902, 12,922; 1903, 10,994; 1904, 8,349.

It is reported that the Lobos seals are now menaced by pelagic sealers, and that a vessel was seized during 1904 by the Government of Uruguay.

In 1888, when in the Straits of Magellan, the writer found the fur-seal herds of that region nearly exterminated by the hunters then working among the Fuegian islands. It is doubtful if they have had any chance to increase since then.

Okhotsk Seal.—The history of Robbin Island, in the Okhotsk Sea, is especially interesting in this connection. This island is about 600 yards in length and less than 100 yards in width, and yet incomplete records show that more than 60,000 seals have been taken there by raiders since 1870. A remnant of this herd has remained to annually repopulate the rookery, which at the present time contains little more than 1,000 seals, and is protected by the Russian Government.

The scattered fur-seal rookeries in the chain of volcanic islands stretching northward from Japan, known as the Kurils, have been destroyed by raiders during recent years. The history of the extermination of these seals, as furnished to the writer by men who engaged in the slaughter, is exceedingly interesting. Notwithstanding the fact that raids were made year after year, the scattered remnants of the herds still clung to their old breeding grounds. The incomplete records at hand show that more than 25,000 seals were taken from the Kuril Islands by raiders since 1880. These rookeries were visited by the U. S. S. Albatross in 1897, and all the rookeries were found to have been wiped out with the exception of one, upon which there were about 100 seals remaining. It is believed that these will be protected by Japan, to which country they belong. The seal inhabiting Robbin Island and the Kuril Archipelago is now known as *Callorhinus curilensis.*

Pribilof and Commander Seals.—The only important strongholds of the diminishing northern fur seals remaining to-day are the Pribilof and Commander islands, in Bering Sea. The United States and Russian governments, to which these islands belong respectively, have for many years endeavored to save from ruin the fur-seal fisheries connected with them. The species established on the Commander Islands is *Callorhinus ursinus*, while that breeding on the Pribilofs is *Callorhinus alascanus.* Although these two species breed upon islands lying in the same latitude and

less than 1,000 miles apart, there is no commingling. The former migrates southwestward in winter along the Asiatic Coast, while the latter migrates southeastward along the American Coast. Upon the discovery of the fur-seal islands of Bering Sea, more than a century ago, seals were found in great multitudes. For many years they were killed indiscriminately, but the Russian Government finally took charge of them and directed the fisheries in such a way that they were regularly productive. The Pribilof Islands, for twenty years after the accession of Alaska, yielded to the United States Government in the taxes on sealskins alone, more than $7,000,000, the price paid for the entire Territory of Alaska. About twenty years ago the practice of pelagic sealing—the killing of seals in the open sea—developed into an extensive industry, since which time the supply of seals has steadily decreased.

Although during the winter months the fur-seal herds migrate into the Pacific Ocean, they are in summer located on their anciently established breeding places in Bering Sea. Under government supervision a certain number of seals on the islands is selected for killing, in accordance with the natural habits of the animals. Fur seals are highly polygamous; every adult male takes possession of a large number of females, the number varying from one dozen to 100 in extreme cases. This highly polygamous habit naturally results in a large surplus of males, which surplus, when the rookeries were in their best condition, amounted to about 100,000 immature males a year on the Pribilofs and over 35,000 a year on the Commanders. These half-grown males herd by themselves, and it is from them that the annual catch of seals on the islands has always been made. The United States and Russian governments have never allowed any disturbing of the breeding rookeries and have never permitted the killing of female seals. The breeding stock upon the islands has therefore remained undisturbed and would, but for the international nuisance of pelagic sealing, have yielded forever a world supply of fur sealskins. This method of sealing, as has been stated, is practiced in the open sea, and permits of no selections being made. Female seals constitute by far the greater part of the pelagic catch. In ten years pelagic sealing in the adjacent waters and in the Pacific Ocean destroyed the value of the Pribilof and Commander islands as government properties. Adjacent to each breeding rookery on these islands lie the so-called "hauling grounds" of the immature males—the class of seals available for killing. The latter are quietly surrounded, and without difficulty

PORTION OF FUR SEAL ROOKERY

Showing two adult males, several adult females, and numerous young.

are driven inland, entirely away from the rookeries of breeding seals, as easily as a band of sheep. The animals are killed, and skinned by the natives. The skins are counted by government agents, and placed in the salt-houses of the lessees for a month's curing, when they are shipped to London, which has always been the world's fur-seal market. The selecting and killing is accomplished without noise or disturbance, and everything is done decently and in order.

The seals arrive at the islands in June; their young are born the last days of June and the early part of July. After the young are born the female seals go to sea to feed, ranging as far as 200 miles from the islands, returning at more or less regular intervals to nurse their young. It is during their feeding excursions that they are taken by sealing vessels in Bering Sea. The killing of females at this season is followed by the starvation of all nursing young on the breeding grounds, the loss of young by starvation corresponding with the number of mother seals taken by vessels.

The different rookery communities are divided up into harems, each one jealousy guarded by a large male. The males arrive at the islands and fight furiously for the possession of territory. The females, arriving soon after the males have established themselves, are divided up among them. The young seals remain with their mothers for about a month, not learning to swim until the latter part of August. The seal herds remain about the islands until late in the fall, when the annual movement into the Pacific Ocean takes place. The class of skins obtained under government direction on the Pribilof and Commander islands is of the highest quality, the animals selected being three-year-old males of nearly uniform size, killed when the fur is in best condition. The following statement, unpublished in part, shows the number of seals of this class taken on the Pribilof Islands during the past five years:

1900.....21,925	1901.....23,066
1902.....22,182	1903.....19,337
1904.....13,273	

Pelagic Sealing.—The pelagic, or ocean catch, is obtained at sea, in season, and out of season. It consists of young and old, male and female, all skins being more or less injured by shooting and spearing—the two methods employed in taking seals at sea. While the pelagic skin has only a value of from $7 to $10, the value of the government skin ranges from $20 to $30. The pelagic

SEALERS STRIPPING THE HIDES FROM HARP SEALS ON THE ICE.

Photograph presented by Job Brothers, St. Johns, Newfoundland.

sealing business, as a whole, has been losing money for several seasons. Renewed efforts were made by the United States Government to put a stop to it. In the meantime American citizens, a small number of whom were engaged in pelagic sealing, have been prohibited from engaging in the pursuit of seals at sea, and Congress passed laws prohibiting the importation of seals taken by pelagic sealing, into the United States. So long as pelagic, or indiscriminate sealing in any form remains, the restoration of the fur-seal fisheries will be impossible. The Bering Sea controversy was precipitated by the seizure by the United States Government of Canadian sealing vessels in Bering Sea. Later on, the matter was placed in the hands of the Tribunal of Arbitration at Paris. This tribunal, having decided that the United States had no jurisdiction over Bering Sea outside of territorial limits, pelagic sealing continued in but slightly modified form. The seal herds are now so decimated that the surplus males available for killing on the Pribilof Islands in 1904 numbered only 13,273, and on the Commander Islands, 8,315.

Pelagic sealing at the present time is engaged in by vessels belonging to British Columbia, a few Japanese vessels participating.* The sealing fleet has decreased from 122 vessels in 1892 to 22 vessels in 1904. Its yearly catch has declined from 61,838 seals in 1894 to 14,541 seals in 1904. Data in full respecting the number of seals taken in pelagic sealing from its inception down to 1897, were published in the United States Report of Fur Seal Investigations for 1897–98. Official data, in part unpublished, showing the number of fur seals taken by the Canadian fleet in American and Asiatic waters from 1898 to 1904 is presented herewith through the courtesy of the Department of Commerce and Labor:

1898.....28,099	1899.....35,344
1900.....35,523	1901.....22,416
1902.....16,143	1903.....14,701
1904.....14,541	

It is now proposed that the pelagic sealing industry of British Columbia be abolished upon the payment of $500,000 by the United States Government, and negotiations are pending. The subject has lately become complicated on account of pelagic sealing by Japanese vessels in Bering Sea, where they are restrained by territorial limits only, Japan not being a party to the temporary restrictions agreed to by Great Britain and the United States.

*Data for Japanese vessels not available.

LIST OF FISHES AND OTHER AQUATIC VERTEBRATES EXHIBITED ALIVE AT THE NEW YORK AQUARIUM DURING THE YEAR 1904.

(Not quite complete.)

Fresh-Water Fishes.*

Native.

Atlantic Salmon	*Salmo salar.*
Landlocked Salmon	*Salmo salar sebago.*
Quinnat Salmon	*Oncorhynchus tschawytscha.*
Brook Trout	*Salvelinus fontinalis.*
Lake Trout	*Cristivomer namaycush.*
Rainbow Trout	*Salmo irideus.*
Steelhead Trout	*Salmo gairdneri.*
Brown Trout	*Salmo fario.*
Hybrid Trout	*S. fario* and *S. fontinalis.*
Hybrid Trout	*S. aureolus* and *S. fontinalis.*
Grayling	*Thymallus montanus.*
Whitefish	*Coregonus clupeiformis.*
Muskallunge	*Lucius masquinongy.*
Pike	*Lucius lucius.*
Pickerel	*Lucius reticulatus.*
Banded Pickerel	*Lucius americanus.*
Crappie	*Pomoxis annularis.*
Long-eared Sunfish	*Lepomis auritus.*
Common Sunfish	*Eupomotis gibbosus.*
Blue-gill Sunfish	*Lepomis pallidus.*
Black-banded Sunfish	*Mesogonistius chætodon.*
Rock Bass	*Ambloplites rupestris.*
Calico Bass	*Pomoxis sparoides.*
White Bass	*Roccus chrysops.*
Large-mouthed Black Bass	*Micropterus salmoides.*
Small-mouthed Black Bass	*Micropterus dolomieu.*
White Perch	*Morone americana.*
Yellow Perch	*Perca flavescens.*
Pike Perch	*Stizostedion vitreum.*
Sauger	*Stizostedion canadense.*
Channel Catfish	*Ictalurus punctatus.*
Mud Catfish	*Leptops olivaris.*
White Catfish	*Ameiurus catus.*
Bullhead Catfish	*Ameiurus nebulosus.*
Catfish	*Ameiurus.*
Yellow Catfish	*Ameiurus natalis.*
Brook Sucker	*Catostomus commersonii.*
Chub Sucker	*Erimyzon sucetta.*
Quillback	*Carpiodes velifer.*
Buffalo-fish	*Ictiobus cyprinella.*

* This list includes four old-world species naturalized in American waters.

Pearl Roach ..... *Abramis crysoleucas roseus.*
Common Roach ..... *Abramis crysoleucas.*
Long-nosed Gar ..... *Lepisosteus osseus.*
Short-nosed Gar ..... *Lepisosteus platostomus*
Mudfish ..... *Amia calva.*
Common Carp ..... *Cyprinus carpio.*
Scale Carp ..... *Cyprinus carpio*, variety.
Mirror Carp ..... *Cyprinus carpio*, variety.
Goldfish ..... *Carassius auratus*, several varieties.
Golden Ide ..... *Idus idus.*
Golden Tench ..... *Tinca*, variety.
Common Tench ..... *Tinca*, variety.
Burbot ..... *Lota maculosa.*
Lake Sturgeon ..... *Acipenser rubicundus.*
Dace ..... *Semotilus.*
Top Minnow ..... *Gambusia.*
Mud Minnow ..... *Umbra limi.*
Johnny Darter ..... *Boleosoma nigrum.*
Paddle-fish ..... *Polyodon spathula.*
Common Eel ..... *Anguilla chrysypa.*

Fresh-Water Fishes.

Foreign.

Paradise-fish ..... *Macropodus viridi-auratus.*
Climbing Perch ..... *Anabas scandens.*
Loaches (several species) ..... *Family Cobitidæ.*
Gourami ..... *Osphromenus olfax.*

Salt-Water Fishes.

Native.

Angler ..... *Lophius piscatorius.*

Bergall ..... *Tautogolabrus adspersus.*
Black-fish ..... *Tautoga onitis.*
Blue-fish ..... *Pomatomus saltatrix.*
Blunt-nosed Shiner ..... *Selene setipinnis.*
Butter-fish ..... *Rhombus triacanthus.*
Burr-fish ..... *Chilomycterus schoepfi.*
Blue Shark ..... *Carcharhinus milberti.*

Cod ..... *Gadus callarias.*
Channel Bass ..... *Scianops ocellatus.*
Conger Eel ..... *Leptocephalus conger.*
Crevalle ..... *Carangus hippos.*
Croaker ..... *Micropogon undulatus*

Dogfish ..... *Squalus acanthias.*
Drumfish ..... *Pogonias cromis.*

Fluke	*Paralichthys dentatus.*
File-fish	*Monacanthus hispidus.*
Hake	*Urophycis tenuis.*
Harvest Fish	*Rhombus parv.*
Killifish	*Fundulus heteroclitus.*
Kingfish	*Menticirrhus saxatilis.*
Lamprey Eel	*Petromyzon marinus.*
Mackerel	*Scomber scombrus.*
Menhaden	*Brevoortia tyrannus.*
Moonfish	*Selene vomer.*
Mutton-fish	*Zoarces anguillaris.*
Mullet	*Mugil cephalus.*
Orange Filefish	*Aleutera schœpfii.*
Pigfish	*Orthopristis chrysopterus.*
Pilotfish	*Seriola zonata.*
Pipefish	*Siphostoma fuscum.*
Pollock	*Pollachius virens.*
Pompano	*Trachinotus falcatus.*
Puffer	*Spheroides maculatus.*
Red Snapper	*Lutianus aya.*
Sand-fish	*Diplectrum formosum.*
Sea Horse	*Hippocampus hudsonius.*
Scup	*Stenotomus chrysops.*
Silverside	*Menidia notata.*
Stickleback	*Eucalia inconstans.*
Stickleback	*Gasterosteus bispinosus.*
Sand Shark	*Carcharias littoralis.*
Shark-sucker	*Echeneis naucrates.*
Sheepshead	*Archosargus probatocephalus.*
Skate	*Raia erinacea.*
Skate	*Raia lævis.*
Smelt	*Osmerus mordax.*
Spade-fish	*Chætodipterus faber.*
Sea Robin	*Prionotus carolinus.*
Sea Robin	*Prionotus carolinus.*
Thread Herring	*Opisthonema oglinum.*
Toadfish	*Opsanus tau.*
Sole	*Achirus fasciatus.*
Spot	*Leiostomus xanthurus.*
Sculpin	*Cottus octodecimspinosus.*
Silver Hake	*Merluccius bilinearis.*
Sturgeon	*Acipenser sturio.*
Short-nosed Sturgeon	*Acipenser brevirostris.*
Sea Bass	*Centropristis striatus.*
Sea Raven	*Hemitripterus americanus.*

Sea Catfish ..... *Hexanematichthys felis.*
Striped Bass ..... *Roccus lineatus.*
Sheepshead Lebia ..... *Cyprinodon variegatus.*

Tom-cod ..... *Microgadus tomcod.*

Winter Flounder ..... *Pseudopleuronectes americanus.*
Weakfish ..... *Cynoscion regalis.*

Yellow Mackerel ..... *Caranx crysos.*

Tropical Fishes from the Bermuda Islands.

Angel-fish ..... *Angelichthys ciliaris.*
Amber-fish ..... *Seriola lalandi.*

Beau Gregory ..... *Eupomacentrus leucostictus.*
Butter Hamlet ..... *Alphestes chlropterus.*
Butterfly-fish ..... *Chætodon ocellatus.*
Blue Tang ..... *Teuthis cæruleus.*
Blue Parrot-fish ..... *Scarus vetula.*
Black Grunt ..... *Hæmulon bonariense.*
Black Grouper ..... *Myteroperca bonaci.*

Coney ..... *Bodianus fulvus.*
Cow-fish ..... *Lactophrys tricornis.*
Cubbyu ..... *Eques acuminatus.*
Chub ..... *Kyphosus sectatrix.*

Four-eyes ..... *Chætodon capistratus*

Grunt ..... *Hæmulon flavolineatum.*
Gray Snapper ..... *Lutianus griseus.*
Green Parrot-fish ..... *Sparisoma viride.*
Green Moray ..... *Lycodontis funebris.*

Harbor Parrot-fish ..... *Sparisoma.*
Hogfish ..... *Lachnolaimus maximus.*

Jewfish ..... *Promicrops guttatus.*

Lady-fish ..... *Harpe rufa.*
Long Jaw ..... *Scorpæna grandicornis.*

Margate-fish ..... *Hæmulon album.*
Mud Parrot-fish ..... *Sparisoma flavescens.*

Nassau Grouper ..... *Epinephelus striatus.*

Princess Rockfish ..... *Myteroperca bowersi.*
Parrot-fish ..... *Pseudoscarus guacamia.*

Queen Triggerfish ..... *Balistes vetula.*

Red Grouper ..... *Epinephelus morio.*
Red Hind ..... *Epinephelus guttatus.*
Red Parrot-fish ..... *Sparisoma abildgaardi.*

Schoolmaster ..... *Neomænis apodus.*
Sergeant Major ..... *Abudefduf saxatilis.*
Spotted Moray ..... *Lycodontis moringa.*
Cardinal Rockfish ..... *Mycteroperca venenosa atua.*
Spot Snapper ..... *Neomænis synagrus.*
Squirrel-fish ..... *Holocentrus ascensionis.*
Surgeon-fish ..... *Teuthis hepatus.*
Slippery Dick ..... *Chlorichthys bifasciatus.*

Trunk-fish ..... *Lactophrys triqueter.*
Triggerfish ..... *Balistes carolinensis.*
Tiger Rockfish ..... *Mycteroperca tigris.*
Yellow Grunt ..... *Hæmulon sciurus.*
Yellow Tail ..... *Ocyurus chrysurus.*

Turtles.

Native.

Loggerhead Turtle ..... *Thalassochelys caretta.*
Hawksbill Turtle ..... *Eretmochelys imbricata.*
Atlantic Green Turtle ..... *Chelonia mydas.*
Pacific Green Turtle ..... *Chelonia virgata.*
Northern Soft-shelled Turtle ..... *Aspidonectes spinifer.*
Southern Soft-shelled Turtle ..... *Aspidonectes.*
Musk Turtle ..... *Aromochelys odorata.*
Slider Terrapin ..... *Pseudemys rugosa.*
Yellow-bellied Terrapin ..... *Pseudemys elegans.*
Geographic Terrapin ..... *Malaclemmys geographicus.*
Diamond-backed Terrapin ..... *Malaclemmys palustris.*
Pond Turtle ..... *Chrysemys picta.*
Spotted Turtle ..... *Clelopus guttatus.*
Muhlenberg Turtle ..... *Chelopus muhlenbergi.*
Wood Turtle ..... *Chelopus insculptus.*
Blandings Turtle ..... *Emydoidea blandingii.*
Snapping Turtle ..... *Chelydra serpentina.*

Salamanders and Frogs.

Native.

Water dog, or Hellbender ..... *Cryptobranchus alleghaniensis.*
Mud-puppy ..... *Necturus maculatus.*
"Congo Snake" ..... *Amphiuma means.*
Common Newt ..... *Diemyctylus viridescens*
Red-billed Salamander ..... *Diemyctylus torosus.*
Blotched Salamander ..... *Amblystoma opacum.*
Red Salamander ..... *Spelerpes ruber.*

Blind Salamander.....*Typhlomolge rathbuni.*
Bull Frog.....*Rana catesbiana.*
Leopard Frog.....*Rana virescens.*
Green Frog.....*Rana clamata.*

Foreign.

Giant Salamander.....*Megalobatrachus maximus.*
European Newt.....Not identified.
Spotted Salamander.....*Salamandra maculosa.*
Axolotl.....*Amblystoma mexicanum.*

Crocodilians.

American Alligator.....*Alligator mississippiensis.*
American Crocodile.....*Crocodilus americanus.*

Mammals.

Harbor Seal.....*Phoca vitulina.*
Manatee or "Sea-Cow".....*Manatus latirostris.*

List of Gifts

TO THE ZOOLOGICAL SOCIETY.

(*Complete from January* 1, 1904, *to January* 1, 1905.)

ALT, HENRY LOUIS, Chief Engineer, The New York Public Library, New York City:
White-Fronted Amazon Parrot (2 specimens).

AMERICAN MUSEUM OF NATURAL HISTORY (*through Mr. Frank M. Chapman, Associate Curator of Birds*), New York City:
Woodcock.

ANDINA, MRS. B., Bedford Park, New York City:
Parrot.

ANONYMOUS:
White-Fronted Goose.

ASHLAND, MRS. A., New York City:
Opossum.

AUCHINCLOSS, HUGH D., New York City:
Snow Leopard (2 specimens).

BACON COMPANY, DANIEL, New York City:
Coati Mundi.

BAKER, WILLIAM, Yonkers, N. Y.:
Raccoon.

BARBOUR, MRS. S. E., Eau Gallie, Fla.:
Diamond-Backed Rattlesnake.

BARBOUR, THOMAS, New York City:
Black Iguana· Crested Iguana.

BARNEY, CHARLES T., New York City:
2 South African Ostriches; 2 North African Ostriches; 3 Common Rheas; 1 Great Billed Rhea; 4 Emeus; 1 Ceram Cassowary; 1 Violet-Necked Cassowary.

BAUST, KARL, New York City:
Sparrow Hawk.

BEEBE, MRS. C. WILLIAM, New York City:
Mexican Deer.

BEEBE, MASTER CULVER, Brooklyn, New York City:
Macaque Monkey.

BREWER, THOMAS, Mount Vernon, N. Y.:
Ring Dove.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES (*through Mr. George Englehardt*), Brooklyn, N. Y.:
The following specimens were collected in Beaver County, Utah: Western Rattlesnake (4 specimens); Bull Snake (3 specimens); Striped Racer (2 specimens); Garter Snake (13 specimens).

BROWNING, JR., JOHN SCOTT, New York City:
Marmoset (1 pair).

CHANLER, MISS, New York City:
South American Lory.

CHAPIN, CARLTON H., Brooklyn, N. Y.:
Squirrel Monkey.

CLARK, ALBERT M., Mount Vernon, N. Y.:
Screech Owl (2 specimens).
CLARK, GEORGE C., New York City:
Punjab Mountain Sheep (5 specimens); Baker's Roan Antelope (female).
COLE, LEON J., Cambridge, Mass.:
Yucatan Chachalaca.
COLEMAN, MISS FLOYD, New York City:
Java Monkey.
COLGATE, MRS. R. R., Sharon, Conn.:
Brood of 5 Sparrow Hawks.
COLLIER, MRS. R. J., New York City:
Iguana.
CONKLIN, H. S., Patchogue, L. I.:
Sharp-Shinned Hawk.
CONNELL, S. WOOD, Pleasantville, Westchester, N. Y.:
Alligator.
CRAIG, MRS. A., New York City:
Indian Ring-Necked Parrakeet.
CRANE, WILLIAM H., New York City:
Green Snake.
CRUICKSHANK, MISS BESSIE J., New York City:
Milk Snake.
DAGGETT, ALLEN B., Brooklyn, N. Y.:
Chipmunk (4 specimens).
DAVIDSON, MRS. R., New York City:
White-Fronted Amazon Parrot.
DAVIS, DR. S. T., Guayaquil, Ecquador, S. A.:
24 Lance-Head Vipers (*Lachesis microphthalmus*); 1 Coral Snake (*Elaps*); 1 Green Tree Snake (*Herpetodryas*); 3 Blind "Snakes" (*Amphisbaena*); 4 Silurians, or Blind Fish.
DEFFIS, MISS EDITH E., Mount Vernon, N. Y.:
Patagonian Lapwing Plover.
DOUGHTY, WILLIAM F., Brooklyn, N. Y.:
American Bittern.
DOVE, ADAM, New York City:
The following specimens were collected by Mr. Dove and Mr. Pearsall in the vicinity of Forestine, Sullivan County, N. Y.: 15 Timber Rattlesnakes, 39 Milk Snakes, 1 Pilot Snake, 4 Black Snakes, 12 Water Snakes, 100 Garter Snakes, 11 Ribbon Snakes, 45 Storer's Snakes, 37 Ring-Necked Snakes, 9 Green Snakes. Total, 273 specimens.
EGGELING, O., New York City:
Great Blue Heron.
ELLSWORTH, L. P., New York City:
South American Parrot.
ENGLEHARDT, GEORGE P. (*The Children's Museum of the Brooklyn Institute of Arts and Sciences*), Brooklyn, N. Y.:
Garter Snake (8 specimens); Box Turtle (13 specimens); Alligator.
FLOYD, WEBB, New York City:
Snapping Turtle.
GILSEY, G. L., New York City:
Rhesus Monkey.
GUILD, MISS C. P., New York City:
Canada Jay.
HAVEMEYER, H. O., New York City:
Double-Crested Cormorant.
HAVEMEYER, JR., MRS. H. O., New York City:
Cinnamon Bear.

HEARST, MRS., New York City:
Alligator.
HENNESSEY, MRS. J., New York City:
American Screech Owl.
HERFORD, OLIVER, New York City:
Black Bear Cub.
HILL, H. R., Williamsport, Pa.:
Alligator (3 specimens).
HILL, J. J., St. Paul, Minn.:
Burrhel Mountain Sheep (2 specimens).
HINKLEY, W. C., Stony Creek, Conn.:
Hawks (2 specimens).
HORNACK, GUSTAV, New York City:
Chameleon.
HUNTINGTON, F. W., Brooklyn, N. Y.:
Canaries (3 specimens).
JAFFREY, MRS. REGINALD T., Irvington-on-the-Hudson, N. Y.:
Ring-Necked Pheasants (6 specimens).
JAMES, NORMAN, Baltimore, Md., CHARLES SHELDON, AND DR. LEONARD G. SANFORD:
European Bison (1 pair).
JASPER, FRED., Chief Engineer, S. S. *Capri*, Brooklyn, New York City:
Three-Toed Sloth.
JENNINGS, WALTER, New York City:
Elk (3 specimens).
JOHNSON, MRS. F. L. (*through Madison Grant, Esq.*), New York City:
Snapping Turtle.
KELLEY, MRS., New York City:
Macaque Monkey; Rhesus Monkey.
KING, MISS MAYTIE, Newark, N. J.:
Flying Squirrel (3 specimens).
KOECHLING BROTHERS, New York City:
Boa Constrictor.
KRAFT, F. W., Bronxville, N. Y.:
Macaque Monkey.
LANDSTREET, FAIRFAX STUART, New York City:
Alligator (2 specimens).
LANGMANN, DR. G., New York City:
24 Strawberry Finches, 24 Black-Headed Mannikins, 2 Three-Colored Mannikins.
LICHTENFELS, WILLIAM, New York City:
Opossum (2 specimens).
LITTLE, DR. GEORGE H., Glens Falls, N. Y.:
Red Jungle Fowl (2 specimens).
LOEWENTHAL, D. J., New York City:
Red-Shouldered Hawk.
LYONS, MRS. J., New York City:
Parrot.
MCKAY, FRANK, New York City:
Screech Owl.
MARCKRES, GEORGE M., Sharon, Conn.:
Holboell's Grebe.
MAUD, MAJOR W. DE S., New York City:
Galapagos Tortoise.
MIDGLEY, DR. JOSEPH E., Brooklyn (*through Mr. Frederic A. Lucas, Curator-in-chief, Brooklyn Institute of Arts and Sciences*)
Canada Porcupine (2 specimens).
MILER, MISS ESTHER, New York City:
Yellow-Bellied Terrapin (3 specimens)

MILLER, C. F., East Orange, N. J.:
Musk Turtle (6 specimens).
MILLIKEN, MRS. A. C., Ardholme, Pottsville, Pa.:
Blue-and-Yellow Macaw.
MINNER, MRS., New York City:
Yellow-Fronted Amazon Parrot.
MOFFET, E. M., Biltmore, N. C.:
Wild Cat.
MUDGE, WILLIAM CLEMENT, Glen Cove, L. I.:
Nine-Banded Armadillo.
MULLER, JOHN C., New York City:
Skin of Resplendent Trogon, collected at Tombala, State of Chiapas, Mexico.
MUSEUM OF COMPARATIVE ZOOLOGY (*through Professor S. Garman*), Cambridge, Mass.:
Star Tortoise (2 specimens).
NAUMANN, E., New York City:
Guinea Pig (2 specimens).
NICHOLSON, A. M., Orlando, Fla.:
White Ibis (3 specimens).
NOWELL, ROWLAND, Schenectady, N. Y.:
Pied-Billed Grebe.
OBROCK, AUGUST, New York City:
Red Fox.
PAINE, A. J., New York City:
Alligator (2 specimens).
PAINE, GEORGE H., New York City:
White-Lipped Peccary.
PALMER, CHESTER W., Brooklyn:
Opossum (2 specimens).
PAUL, JOHN J., Watertown, Fla.:
Diamond-Backed Rattlesnake (2 specimens).
PAYNE, COLONEL OLIVER H., New York City:
Male Indian Elephant, "Gunda."
PEARSALL, MORRIS, New York City:
The following specimens were collected by Mr. Pearsall and Mr. Dove in the vicinity of Forestine, Sullivan County, N. Y.: 15 Timber Rattlesnakes, 39 Milk Snakes, 1 Pilot Snake, 4 Black Snakes, 12 Water Snakes, 100 Garter Snakes, 11 Ribbon Snakes, 45 Storer's Snakes, 37 Ring-Necked Snakes, 9 Green Snakes. Total, 273 specimens.
POMPERAUG VALLEY GAME CLUB (*through Edward S. Hine*), New Rochelle, N. Y.:
Great Horned Owl.
POTTER, MISS MARTHA:
Ruffed Lemur.
RACEY, C. H., Waveland, Fla.:
Red-Tailed Hawk.
REACH, MRS. CHARLES H., Brooklyn, N. Y.:
Java Sparrow (4 specimens).
ROBY, MRS. E. A., New York City:
Brown Thrasher.
ROGERS, WILLIAM A., Yonkers, N. Y.:
American Crow.
SALISBURY, MRS. JUNIATA, Carbondale, Pa.:
Common Grebe.
SCHILLING, ROBERT, New York City:
Gray Rattlesnake.
SCHMIDT, DR. JULIUS, Zoologisk Have, Copenhagen, Denmark:
3 Greenfinches, 2 European Goldfinches, 2 Chaffinches, 1 Linnet.

Schlitz, Alfred, New York City:
Opossum.
Schopbach, Fred. C., New York City:
American Crow.
Schott, Louis, New York City.
American Bittern.
Scott, W. E. D., Princeton, N. J.:
Red-Necked Grebe.
Seward, Hugh W., West Palm Beach, Dade County, Fla.:
Crocodile (small specimen).
Sheldon, Charles, New York City:
Mexican Gopher Snake.
Shoemaker, Ernest, Brooklyn, N. Y.:
Milk Snake (2 specimens).
Skiddey, W. W., Stamford, Conn.:
Tegu.
Solomon, Charles S., New York City:
Java Monkey.
Steed, W. H., New York City:
Diamond-Backed Terrapin.
Streeter, D. D., Brooklyn, N. Y.:
Raccoon.
Such, Jr., Mrs. Goerge, Newark, N. J.:
Java Sparrow (2 specimens); Black-Headed Mannakin; Spice Finch (2 specimens).
Swanson, Otto, South Britain, Conn.:
Copperhead Snake.
Tesiny, Nicholas, Bridgeport, Conn.:
Red-Tailed Hawk.
Thorndike, Miss, New York City:
Horned Lizard.
Tompson, Mrs. Fred. A., New York City:
Orange-Winged Love Birds (5 specimens).
Underhill, Richard D., Watchung, N. J.:
Woodchuck.
Van Beek, Theodore, First Officer, S. S. *El Dorado*, New York City:
Duck Hawk (4 specimens).
Wetstein, William, New York City:
Alligator (3 specimens).
Whealton, Louis N., New York City:
2 Mute Swans, 1 Blue-Winged Teal, 1 European Widgeon, 2 Red-Headed Ducks, 12 Baltimore Orioles, 6 Mockingbirds, 6 Cardinals, 14 Black Skimmers, 23 Common Terns, 1 Tiger Bittern
Whitlock, Lester, New York City:
Alligator.
Ziegle, Anton M., New York City:
Blue-and-Yellow Macaw.

Miscellaneous List.

Trapped by Mr. C. William Beebe, December 31, 1904.

8 White-Throated Sparrows, 2 Song Sparrows, 2 Goldfinches, 1 Hermit Thrush.

Hatched in the Park during 1904, and not catalogued thus far.—December 31, 1904.

4 Canada Geese, 2 Silver Pheasants, 2 Ring-Necked Pheasants, 4 Wood Ducks, 9 Jungle Fowl, 6 India Peacocks, 32 Mallards.

Gifts of Plants.

BALCOM, DR. IRVING S., Fordham, New York:
Two Agaves; One Oleander, 7 feet high.
COCKROFT, MISS MARY T., Saugatuck, Conn.:
One large Seaforthia Palm, 18 feet high; three large *Araucaria excelsa* (Norfolk Island Pine); three large Yuccas; one large Clivia; one large Hymenocallis. (All exceptionally fine plants.)
EICHLING, MISS E., New York City:
One Rubber Plant, 8 feet high.
POST, MRS. E. F., Bedford Park, New York:
One Rubber Plant, 6 feet high.
SMITH, MRS. PHILIP, Bedford Park, New York:
Two Rubber Plants, 5 feet high; 4 small Kentias.

Gifts to the Library.

AMERICAN MUSEUM OF NATURAL HISTORY, New York City:
Bulletin of the American Museum of Natural History, Vol. XVIII Part 2, and Vol. XIX.
Memoirs of the American Museum of Natural History (*Osborn*) Vol. I, Part 8.
BRESLAU ZOOLOGICAL SOCIETY:
Schlesische Gesellschaft fur Vaterlandische Cultur, Breslau—1903.
Die Schlesische Gesellschaft fur Vaterlandische Cultur, Breslau (2 parts).
BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, New York City:
Medusae of the Bahamas.—Vol. I. (*Mayer.*)
FIELD-COLUMBIAN MUSEUM:
The Fresh Water Fishes of Mexico, etc.—Vol. V. (*Meek.*)
GEOLOGICAL SURVEY OF CANADA:
Annual Report and Maps—Geological Survey—1900. Vol. XIII.
Catalogue of Canadian Birds. Part 3. (*Macoun.*)
HORNADAY, WILLIAM T.:
The American Natural History.
LYON, MARCUS W., JR. (*Smithsonian Institution*):
Classification of the Hares and Their Allies. (*Lyon.*)
MUSÉE NATIONAL DE BUENOS AIRES, Florentino Ameghino, Directeur:
Recherches de Morphologie, etc. (*Ameghino.*)
NEW YORK BOTANICAL GARDENS, Bedford Park, New York City:
The following pamphlets: Mammals, 17; Birds, 27; Reptiles, 2; Veterinary, 6; Insects, 18; Miscellaneous, 33. Total, 103.
ONEIDA COMMUNITY, LIMITED, Oneida, New York:
The North American Trapper, Vol. I (8 numbers).
PHILADELPHIA ACADEMY OF SCIENCES, Philadelphia, Pa.:
Proceedings of the Academy of Natural Sciences, 2 Vols.
PROVINCIAL MUSEUM, (*through Francis Kermode, Curator*):
Catalogue of British Columbia Birds.
RUSS, EDWARD, Hoboken, New Jersey:
Birds of California (*Wheelock*)
American Birds (*Chichester.*)
SMITHSONIAN INSTITUTION, Washington, D. C.:
Annual Report of the Smithsonian Institution, 1902.
UNITED STATES DEPARTMENT OF AGRICULTURE, Biological Survey:
Distribution and Migration of North American Warblers (*Cooke.*)

Yearbook of the United States Department of Agriculture, 1903.
Report of Subcommittee on Territories.
Fur-Seals of Alaska—Committee on Ways and Means.

UNITED STATES FISH COMMISSION:
Reports of the Commissioner—United States Fish Commission Parts 26, 27, and 29.

UNIVERSITY OF MONTANA:
Additional Notes on Summer Birds, etc. (*Silloway.*)

YOUNG, FRED. S.:
Natural History in Shakespeare's Time. (*Seager.*)

Miscellaneous.

SHIELDS, G. O., New York City:
5 Drawings of Birds by L. Gray, and 10 Drawings of Birds by Allen Brooks.

Gifts to the Aquarium.

ABBEY, R., Brooklyn, N. Y.:
Young Alligator.

AMERICAN MUSEUM OF NATURAL HISTORY (*through Dr. H. C. Bumpus Director*):
Dry specimens for Laboratory: 1 Cassis corntus, 1 Nautilus pompilius (entire), 1 Nautilus pompilius (cut), 1 Glycimerus generosa, 1 Pentaceros, 1 Walrus tusk, 1 Saw of sawfish, 1 Plank with Shipworms, 1 Giant Crab, 1 Narwhal tusk, 1 Triton tritonis.

BARBOUR, THOS., Cambridge, Mass:
Hawksbill Turtle.

BARRY, D. D., New York City:
Turtle.

BISHOP, HENRY, Baltimore, Md.:
16 Japanese Fancy Goldfish.

BLAKE, CAPT. WM. H., New York City:
Hawksbill Turtle.

BROWNELL, MISS GERTRUDE MAY, Brooklyn, N. Y.:
2 Alligators.

BRAKELEY, J. TURNER, Hornerstown, N. J.:
Collection of mosquito larvæ.

CAMMANN, PHILIP G., New York City:
Alligator, Spotted Turtle.

CASTROP, HENRY J., New Rochelle, N. Y.:
60 Sea Anemones.

COCHRAN, ROBT. T., & Co., New York City:
Alligator.

DETROIT AQUARIUM, Detroit, Mich. (*through R. E. Bolger, Commissioner of Parks, Detroit*):
10 Whitefish, 11 Rock Bass, 12 Crappie, 5 Pike-perch, 8 Brook Sucker, 1 Muskallunge, 3 Lake Sturgeons.

DILLON, MRS. J. A., Orange, N. J.:
Alligator.

DORR, J. FRANK, AND LANGE, WILLIAM, Staten Island, N. Y.:
Loggerhead Turtle.

ELMORE, MRS. NELLIE, New York City:
Diamondbacked Terrapin, Box Tortoise.

EMERSON, MRS., Brooklyn, N. Y.:
Wood Turtle.
FAKE, EDWARD, Rutherford, N. J.:
Hawksbill Turtle.
FOOTE, F. L., New York City:
3 Hawksbill Turtles.
FOSTER, F. J., Newark, N. J.:
Snapping Turtle.
FOTTRELL, T. C., Brooklyn, N. Y.:
Alligator.
FRIEDRICK, B., New York City:
Alligator.
GARRISON, CAPT., New York City:
Alligator.
GRIDLEY, W. T., New York City:
Box Tortoise.
HALEY, CALEB, & Co., New York City:
Trumpetfish.
HARTMAN, PETER, & Co., New York City:
Green Turtle.
HEALEY, JOHN, New York City:
Mantis Shrimp.
HEFFERMAN, GEO. H., New York City:
Large-mouthed Black Bass.
HEMICKE, G., New York City:
Hawskbill Turtle.
HILLS, DR. T. MORTON, Willimantic, Conn.:
3 Frogs.
HIRZEL & FETMANN, New York City:
Alligator.
HITE, MISS C., New York City:
Alligator.
HODGES, A., New York City:
Alligator.
KING, H. R., Arlington, N. J.:
Alligator.
KLINTMAN, MRS. A., Point Pleasant, N. J.:
Spotted Turtle.
KOHNKE, DR. QUITMAN, New Orleans, La.:
Collection of mosquito larvæ.
McCOY, A. B., Bath Beach, L. I.:
2 Alligators.
NEW YORK FOREST FISH & GAME COMMISSION, Albany, N. Y. (*through J. D. Whish, Secretary*):
5 Muskallunge, 2 long jawed gars, 3 small-mouthed black bass, 1,000 eggs of brook trout.
NEW YORK ZOOLOGICAL PARK, New York City (*through W. T. Hornaday, Director*):
Green Turtle (280 pounds).
PAGE, H., Chatham, N. J.:
Alligator.
PHILLIPS, MRS., New York City:
2 Spotted Turtles.
POTTER, MISS ALICE, New York City:
Bullfrog.
REDFIELD, EDWARD T., Closter, N. J.:
5 Frogs, 14 salamanders, 3 muhlenberg turtles, 1 newt, 16 tadpoles, 3 painted turtles, 2 spotted turtles.
SADLER, C., Philadelphia, Penna.:
Crocodile.

SCHNOOR, JACOB, Belford, N. J.:
Loggerhead Turtle.
SCOTT, FRED., Staten Island, New York:
Bullfrog.
SCRYMSER, MISS K. F., Elizabeth, N. J.:
Alligator.
SHAFFER, MRS. C. J., New York City:
Alligator.
SHERWOOD, MRS. A. N., New York City:
2 Alligators.
SOUTHARD, MRS. C. Z., Brooklyn, N. Y.:
Alligator.
SOUTHSIDE SPORTSMENS CLUB (*through Geo. P. Slade, President*), Oakdale, L. I.:
16 Brook Trout, 12 Hybrid Trout, 1 Brown Trout, 14 Rainbow Trout.
SPRINGER, MRS. ANTON, Plattsburgh, N. Y.:
Alligator.
STOBER, F., Brooklyn, N. Y.:
2 Bullfrogs.
THOMMAY, H. H., Jersey City, N. J.:
4 Alligators.
TOWNSEND, C. H., New York City:
27 Turtles (2 species).
TUXEDO CLUB, Tuxedo, N. Y. (*through Edwin C. Kent*):
4 large steelhead trout, 28 two-year old steelhead trout, 34 land-locked salmon, two years old, eggs of the brown trout.
UNITED STATES FISHERIES BUREAU, Washington, D. C. (*through Hon. Geo. M. Bowers, Commissioner*):
4 large carp, 6 golden tench, 4 green tench, 6 adult crappie, soft-shell turtles, terrapin, snapping turtle, 12 paddlefish, 4 long-nosed gar, 2 wall-eyed pike, 110 large-mouth bass, 12 white bass, 1 mudfish, 15 carp, 12 yellow catfish, 18 buffalofish, 24 fresh-water drum, 40 blue-nosed sunfish, 5 sauger, 4 pike-perch, 72 crappie, 8 red-horse, 8 grayling, 5 whitefish, 16 hybrid trout, 6 lake trout, 12 quillback, 3 short-nosed gar, 42 spotted catfish, 12 brook trout, 2 channel bass, 1 margate fish, 1 schoolmaster, 2 nassau grouper, 2 gray snappers, 10 filefish, 6 pompano, 7 sheepshead, 1 pilotfish, 11 jumping mullet, 1 spadefish, 10 catfish, 6 red hind, 6 sea-horse, 4 red-snappers, 3 squirrelfish, 2 common triggerfish, 2 queen triggerfish, 1 rockfish, 6 croakers, 14 burfish, 1 remora, 1 trunkfish 1 angelfish, 1 yellowtail, 1 loggerhead turtle, 1 green turtle, 1 seal (loaned).
36,000 *fish eggs as follows:*
5,000 brook-trout eggs, 2,000 Atlantic salmon eggs, 10,000 whitefish eggs, 10,000 lake trout eggs, 1,000 quinnat salmon eggs, 5,000 rainbow trout eggs.
The following through the New York *Sportsmens Show:*
1,000 brook trout eggs, 1,000 rainbow trout eggs, 500 land-locked salmon eggs, 500 Atlantic salmon eggs.
Total, 36,000.
VICKERY, MRS. CLARA, Jersey City, N. J.:
Alligator.
VOIGHT, FRED, Brooklyn, N. Y.:
Snapping Turtle.
WEIL, C. A., New York City:
4 Painted Turtles.
WHEALTON, L. N., New York City:
2 Diamond-backed Terrapin.
WHELESS, THOS. H., New York City:
1 Box Tortoise.

Gifts to the Aquarium Library.

BIEN, JULIUS & Co., New York City:
48 Colored plates of fishes of Porto Rico, 71 colored plates of fishes of Hawaiian Islands.
CARTER, E. N., St. Johnsbury, Vt.:
American Fish Culturist for 1904.
EHRENBAUM, DR. E., Helgoland, Germany:
Fische mit festsitzenden eiern.
FELT, DR. E. PORTER, Albany, N. Y.:
Mosquitoes of New York State.
FIELD COLUMBIAN MUSEUM, Chicago, Ill., (*through F. J. V. Skiff, Director*):
Pamphlets on fishes and other cold-blooded vertebrates.
GRANT, MADISON, New York City:
First and Seventh Reports of the New York Forest, Fish and Game Commission.
KOHNKE, DR. QUITMAN, New Orleans, La.:
Papers on the mosquito problem.
MUSEUM OF THE BROOKLYN INSTITUTE, Brooklyn, N. Y. (*through Dr A. G. Mayer, Curator in Chief*):
Memoirs and Bulletins.
NEW YORK STATE FOREST, FISH AND GAME COMMISSION, Albany, N. Y.:
Portfolio of colored plates of fishes and game of New York
PARKER, DR. G. HOWARD, Cambridge, Mass.:
18 Pamphlets on Fishes and Invertebrates.
SMITH, DR. JOHN B., New Brunswick, N. J.:
Pamphlets on mosquitoes.
SMITHSONIAN INSTITUTION, Washington, D. C. (*through Professor S. P Langley, Secretary*):
Annual Reports and Bulletins.
TOWNSEND, C. H., New York City:
The American Lobster—Herrick.
UNITED STATES FISHERIES BUREAU, Washington, D C. (*through Hon. Geo. M. Bowers, Commissioner*):
Annual Reports and Bulletins.
WEEKS, HENRY CLAY, Bayside, L. I.:
Report of Anti-Mosquito Convention, 1903.

Purchases.

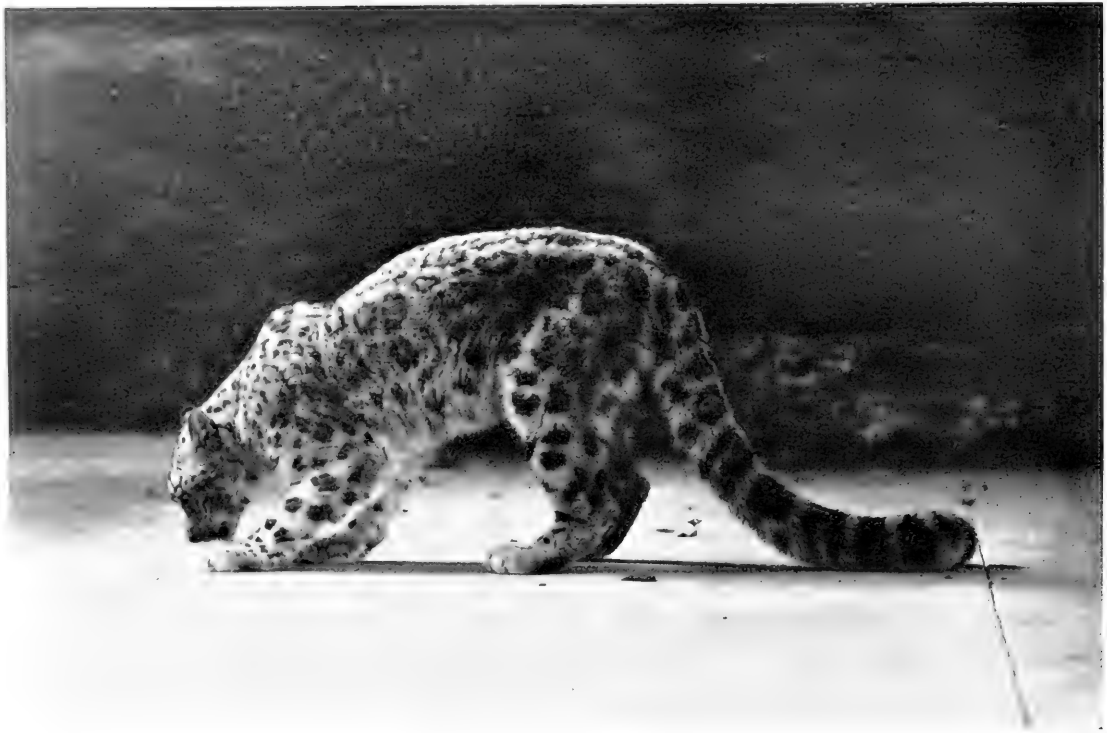
STEAMER *Angler*—collections from the fishing banks off the New Jersey Coast:
18 horse mussels, 5 starfish, 24 skate, 90 sea ravens, 58 bergalls, 25 muttonfish, 28 sculpin, 2 anemones, 14 puffers, 1 rock crab, 2 hake, 52 sea ravens, 10 fluke, 6 menhaden, 75 sea bass, 14 porgies, 4 scup, 12 dogfish, 28 blackfish, 1 cunner, 3 conger eel, 8 anglers, 1 codfish.
JACOB & WM. SCHNOOR—collections from the pound nets at Port Monmouth, N. J.:
2 sturgeon, 3 large sharks, 7 large drumfish, 5 weakfish, 10 spiny boxfish, 10 orange filefish, 10 young sea robins, 4 puffers, 1 slimy toadfish, 1 pilotfish, 7 menhaden, 1 yellow mackerel, 1 dogfish, 1 sea lamprey, 1 codling, 1 hake, 6 sculpin, 4 winter flounders.
TROPICAL FISHES—from Bermuda:
34 hinds, 50 squirrelfish, 3 crawfish, 1 margate-fish, 42 sergeant majors, 5 butterfly-fish, 9 hog-fish, 134 angel-fish, 12 lobsters,

TROPICAL FISHES—*Continued:*

59 surgeon fish, 2 octopus, 11 trunk-fish, 14 groupers, 3 rockfish, 5 lady-fish, 22 coneys, 3 spotted moray, 1 file-fish, 1 jew-fish, 2 butter hamlets, 1 sculpin, 90 four-eyes, 1 cubbyu, 1 schoolmaster, 11 yellow tails, 73 parrot-fish.

OTHER PURCHASES:

7 harbor seals, 6 bullfrogs, 1 sturgeon, 17 turtles, 1 alligator.



SNOW LEOPARD

OSTEOMALACIA OF PRIMATES IN CAPTIVITY.

A CLINICAL AND PATHOLOGICAL STUDY OF "CAGE PARALYSIS."

FROM THE MEDICAL DEPARTMENT OF THE NEW YORK ZOOLOGICAL PARK.

By HARLOW BROOKS and W. REID BLAIR.

"CAGE paralysis" or "cripples" is a condition of such frequent occurrence, particularly among the primates, that it forms one of the most serious obstacles to the maintenance of large and complete collections of wild animals in captivity.

Judging from the frequent inquiries which have been addressed to us regarding this condition, and from statistical reports from other collections, we have been more fortunate in the small number of fatalities from this complaint than most parks of similar size, and yet the death-rate from this disease has headed the list among our primates since tuberculosis has practically been eradicated from the collection. For this reason, and as a matter of sure scientific interest, our attention has been particularly directed toward "cage paralysis" for the past two years.

In the Report of the New York Zoological Society for 1903, one of us (Brooks) presented a small series of cases studied from the standpoint that the disease was primarily one of the central nervous system. As a result of this preliminary study it was concluded that the condition, as recognized by animal men, was not a true disease entity, but that it really represented a very wide group of spinal and cerebral disorders, probably covering as extensive a field as the similar groups of human cerebro-spinal diseases.

During the past year we have carefully observed all instances of the malady as it appeared in our collection and, as a result, one of us (Blair) has noted a series of lesions which, after considerable study, we believe to be primary and essential to the disease in any form, and which causes us to unhesitatingly class it as osteomalacia.

The studies appearing on diseases of wild animals are so few and so widely distributed throughout the enormous literature of zoology, veterinary medicine, human and experimental medi-

cine, and in general scientific productions, that it is indeed a most difficult task for one to assure himself that any subject has heretofore remained undescribed. It is perhaps for this reason that we have found but very few references to osteomalacia occurring in wild animals and, indeed, until some time after we ourselves had fully decided as to the nature of the disease, we were unaware that the condition had been previously noted. The recognition of "cage paralysis," familiar to all animal men under that name, as osteomalacia, we believe to be now stated for the first time.

Osteomalacia occurring in *domestic* animals has long been recognized and has been fully studied, particularly by the work of Roloff, Ribbert, Pillvax, Rool, Haubner and Anaker.

Of these writers but one, in so far as we have been able to find, has described the disease as occurring also in wild animals. Roloff as early as 1867 (Virchows Archiv. Bd. XXXVII, s. 433) mentions the condition, but does not discuss it at any length as applied to these animals.

It is not infrequently mentioned in various Zoological Society reports, but, so far as we have been able to learn, in none of them has the true nature of the condition been ascertained. Thus among the earlier records we find Ram Brahma Sányál, Superintendent of the Zoological Garden of Calcutta ("Hand-Book of the Management of Animals in Captivity in Lower Bengal," 1892), mentions the prevalence of the "cripples" among Diana and other monkeys. He attributes the disease to damp and cold, stating that no treatment relieved the "stiffness" which is characteristic of the early stages of the malady. Sányál, however, considered it as primarily a paralysis, and did not note the osseous lesions.

Scattered throughout the comparative studies of the central nervous system are also occasional references to the disease, treated in all instances as a primary nervous disorder, an opinion with which most animal men coincide. Undoubtedly osteomalacia of the Primates, as in man, has long been confused with rachitis, which it very closely similates, particularly in the slowly progressive cases where extensive deformities have taken place.

The lesions in the bones are very similar in both cases, and even clinically they closely resemble each other. The essential point of difference exists in that in rachitis we are dealing with a congenital state in which the bones were never normally calcified, while in osteomalacia the disease is an acquired one in which the once normally calcified bones become decalcified.

The differentiation, however, is just as clear and the same as

PLATE I. CASE NUMBER 6.—SAPAJOU MONKEY.

Showing last stages of osteomalacia, with shrunken extremities and marked curvature of the spinal column.

in man, and is now fully described in all text-books, and in many monographs treating of osteomalacia and rachitis.

Although our observations of the disease are as yet limited, and though the cases presented have been in most instances unsatisfactorily studied, we believe it best to present our findings in the fullest possible way, principally for the reason of the great importance of the disease to zoological science and in order that zoological collections may at once derive whatever of benefit lies

in our work, in the hope that concerted study may render the prevention and treatment of the disease more clear and ultimately successful.

OCCURRENCE.

The occurrence of this disease is not restricted to animals from any particular geographical area, or to any special season of the year, having come under our observation in each of the four seasons.

Species Affected.—The disease among wild animals occurs in sapajous, macaques, Diana monkeys, green monkeys and baboons, in point of frequency in the order named.

Age.—The disease may affect either young or old animals. While there seems to be no marked relation between age and occurrence, it more frequently manifests itself in those animals which have been in captivity for some time, rather than in those recently arrived.

Sex.—The disease occurs in both sexes. The greater proportion under our observation have been males. This is exactly contrary to the condition in man, where osteomalacia occurs almost exclusively in females, and is most commonly seen bearing a close relationship to the puerperal state. It is therefore interesting that in the species most closely allied to man, it occurs without this relationship, and in animals in which procreation during captivity is exceptional.

ETIOLOGY.

While confinement has a manifest influence, we are still in the dark concerning the *essential* etiological factors in the causation of this affection.

A deficiency of earthy salts in the food would seem to be a natural explanation. The presence of an infection has been suggested, but if this exists, it must be habitually introduced in the food or water, rather than transmitted from animal to animal. Healthy animals have been associated with those diseased for an indefinite length of time, without apparent injury; and comparison to a similar condition in man, would seem to exclude this possibility. A morbid peculiarity of the constitution, and a special predisposition seems to be requisite for the causation. When this susceptibility to the disease exists, then exposure in ill-ventilated, small and dark cages probably acts as an exciting cause.

Confinement in the smaller cages apparently offers some predisposition to the disease, since we have observed more cases developing in the smaller and darker side compartments than in the larger, more airy and better lighted ones. It is interesting to note in this connection that there has never been a single case in the large lemur cage, which is situated in the main corridor of the Primates' House in the New York Zoological Park, and which receives a great abundance of sunlight during a large part of each day. In this cage the conditions much more nearly approximate the normal habitat of the primates than we are able to afford in the other portions of the building.

Age appears to play no definite factor in the production of the disease as we have seen it; though, as stated above, the time in captivity does seem to be an important consideration.

The question of possible primary haemic conditions must not be neglected, particularly as the disease apparently occurs most commonly, under conditions in which we might naturally expect a greater or lesser degree of anaemia. We believe that primary anaemia is not a frequent introductory condition, though secondary anaemias are doubtless frequently present in the early, as well as the later, stages of the disease, but apparently not as an essential primary inductive agent.

SYMPTOMS.

While there are no positive premonitory symptoms which are characteristic of this malady, still there are certain signs, the appearance of which will justify a provisional diagnosis. One of the first symptoms manifested is that the subject becomes less active than usual, instead of running and leaping about from swing to swing, it sits on the floor or isolates itself in some far corner of its cage and takes very little interest in its surroundings except at feeding time; for the appetite generally remains good up to the later or terminal stage of the disease.

Gradually a noticeable stiffness is apparent when the animal moves about. This stiffness is most marked in the posterior extremities and generally progresses quite rapidly. During this stage, the animal is apparently free from pain, but of this one cannot feel sure, since we have observed that, as a rule, monkeys can stand considerable pain without any external manifestation of suffering. Later the movements of the animal become quite cumbersome, its actions resembling those of animals suffering from rheumatism. If the animal is closely examined, even at

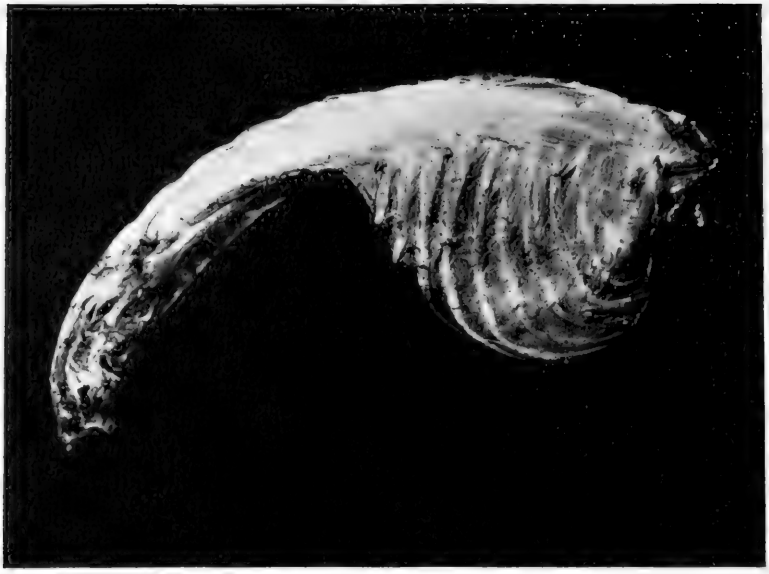


PLATE II. CASE NUMBER 6.—THORAX AND SPINAL COLUMN OF MONKEY SHOWN ON PAGE 131, EXHIBITING DEFORMITIES.

this early stage of the disease, it will be found that there are marked changes going on, especially in the bones.

Considerable alteration in the form of the thorax will be found. The resistance of the bones is greatly diminished, and they break under a slight strain, so that fractures (particularly green stick fractures) and distortions are apt to be met with. Marked osseous changes may take place, apparently without constitutional symptoms. However, the patient soon loses its spirit and the general health fails.

The skin is dry and the hair lustreless. There is beginning emaciation, the muscles becoming soft and flabby. The animal is generally subject to frequent attacks of indigestion, accompanied by swelling and abdominal pain. No urinary manifestations are present in this stage of the disease.

Partial paralysis of the posterior extremities soon comes on, with atrophy of the muscles of the loin and limbs. The progress of the disease is now generally quite rapid, and the animal lies huddled up in a corner of its cage; if forced to move, rises [illegible] and with difficulty, and moves the limbs rigidly, as if [illegible] without joints. Its locomotion is extremely cumber

some, generally using its long arms as a cripple would use crutches.

With constant decubitus the patient fails, rapidly becoming emaciated and weak. Abscesses and sloughs are common over the bony prominences of the pelvis and at the base of the tail. These ulcerations have a tendency to spread, forming irregular and sometimes deep sloughing excavations, with no tendency to heal. No pain is evident by manipulation of the partially paralyzed extremities. The *musculo-tendinous* reflexes are decreased or obliterated.

The paralysis of the posterior limbs increases, and the animal, becoming completely paraplegic, loses sphincteric control, with incontinence of urine and fæces. Tactical and pain anesthesia develop in the involved areas so that a pin may be trust into the feet or legs without the animal apparently noticing it.

Various distortions of the bony frame-work develop, even in the early stages, and these changes are most frequently noted in spinal column and thorax, as well as in the long bones of the extremities, depending largely upon the superincumbent weight and muscular contraction. A deformity simulating the classical "pigeon breast" is shown in an accompanying photograph. (Plate 3.) Respiratory embarrassment frequently results from these deformities. General anaemia and bronchitis are nearly always associated with advanced cases.

While we have tried to picture typical cases of "cage paralysis," it is important to note that there is a wide margin of difference in respect to the degrees of severity which may characterize different cases, and the diagnosis is by no means easy, even to careful observers, in the early stages of the disease.

We believe several of the cases which have occurred in our service were already well inaugurated when the animals were received from the dealers, and, notwithstanding the fact that all new animals are submitted to a searching examination before admission, cases have not unfrequently remained unrecognized until the middle or later stages of the malady.

PATHOLOGICAL ANATOMY.

General Nutrition.—As a rule, the general nourishment of the body does not appear to suffer in the early or middle stages of the disease. The adipose is abundant, of normal color and consistence, as the animal eats well. As the disease progresses, a gradual shrinkage of the paralyzed extremities takes place (to

be discussed under the appropriate headings); but the body, as a whole, does not suffer until secondary complications, such as bronchitis, hypostatic pneumonia and similar terminal conditions arise.

For these reasons it happens that the animals often remain satisfactory subjects for exhibition until the deformities or paralyses become sufficiently marked to attract the attention of the ordinary observer. In some cases, where the appetite remains good, probably as the result of the lack of normal exercise, the animal, particularly the baboons, may become too fat. Emaciation is, however, eventually an accompaniment of the terminal stages of the disease in all except the very acute and actively progressive cases.

Skin and Mucous Membranes.—The color of the skin and mucous membranes depends largely on the condition of the blood. In the middle and later stages the hair becomes rough and brittle, or it may fall out in places. The surface of the skin is covered with thickened epithelial scales. Trophic ulcers at points of pressure, as over the tuberosities of the ischium, are common in the terminal state. They are indolent, gangrenous and show little tendency to heal. The mucosa of the tongue becomes covered with a thick coating and sores develop on the teeth. As a rule these changes appear only in the later part of the disease and in the earlier stages no changes in these membranes are to be found. As a rule, the sub-dermal fat of the paralyzed extremities finally becomes atrophic.

Blood.—On account of the lack of a well-established normal standard in each of the various species, blood counts and haemoglobin tests are unsatisfactory and we must rely, for judgment as to the haemic state, entirely on the general appearance of the blood and on the tissues in which it circulates, also on the morphological variations in the character of the cells. With these points as the basis of our comparison we believe that, as a rule, little or no change in the morphology of the blood takes place, except in the later stages of the disease, where many complicating conditions arise. We have been unable to substantiate the increase of eosinophiles described by Neusser in man (Weiner Klinische Wochenschrift, Nr. 3, 1892), nor the lymphocytosis found by Reider (Beitrage zur kentnisse der leucocyten, 1892). Leucocytosis naturally develops in the terminal conditions, as do also the various types of abnormal red cells (see cases X and XI). When one considers the very extensive disease of the bone marrow and the frequency with which, in other conditions, eosino-

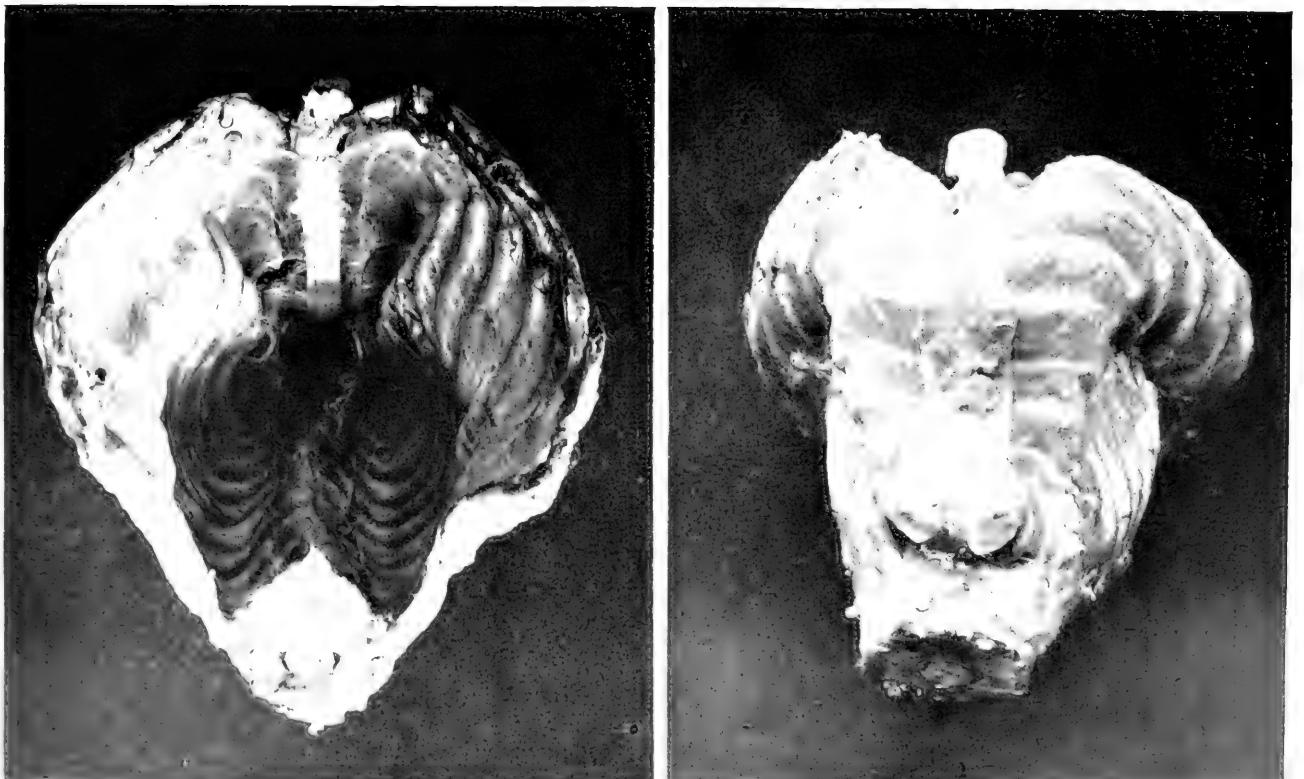


PLATE III. CASE NUMBER 8.- THORAX OF GOLDEN BABOON.

Showing marked deformity of the thorax.

philia accompanies such disturbance, one would naturally expect a relative increase, at least in the eosinophilic cells. Though this does not appear to be the case in the instances observed by us, it is quite possible that in the earlier stages, when involvement of the bone marrow *begins* the conditions may be present and subsequently disappear. The gross appearances of the blood, in terminal cases, exhibit the usual characteristics of extreme anaemia and coagulation is oftentimes very much retarded.

Muscles.—No definite alteration, which can be looked upon as other than entirely secondary, has been found in the muscles. There are no changes in those of the paralyzed extremities, except a general wasting with fat absorption, though occasionally there is a relative over-deposition of adipose. The muscle cells become atrophied, but no nodes of disintegration or of nuclear proliferation have been seen and the atrophy seems to be entirely one of disuse, occasionally accompanied by a pressure-atrophy following over-deposit of fat. The muscles away from the immediately involved extremities show no changes, except such as are entirely dependent on the secondary conditions induced by the disease. No lesions of the smooth muscle distribution have been found.

Osseous System.—Disease of the bony tissue appears to us to be the essential characteristic of the disorder and it is on these changes that we classify the disease as osteomalacia, identical in all its essential particulars with the condition so fully described as it occurs in man and the domestic animals.

All the bones of the body, even those of the skull, eventually become involved. The changes are most obvious and deformity most prominent in those bones which may be looked upon as the *supporting framework* of the body; these are the bones of the lower extremities, particularly the femurs, the spinal column and those of the thoracic cage. The pelvis is relatively much less deformed than in man, probably because the weight of the body is less suspended on these bones in the monkeys, which ordinarily use the upper extremities for the purposes of locomotion, together with the lower. Very likely it is for this same reason that the thorax shows very early and much more pronounced deformities than is the cases in the human.

One of the very earliest osseous deformities, consists in a bowing, usually a posterior kyphosis of the spinal column, most marked in the dorsal region associated with a marked hypertrophy of the lumbar and sacral vertebrae. Lateral deviations are, in our experience, out of the ordinary. This deformity is quite as

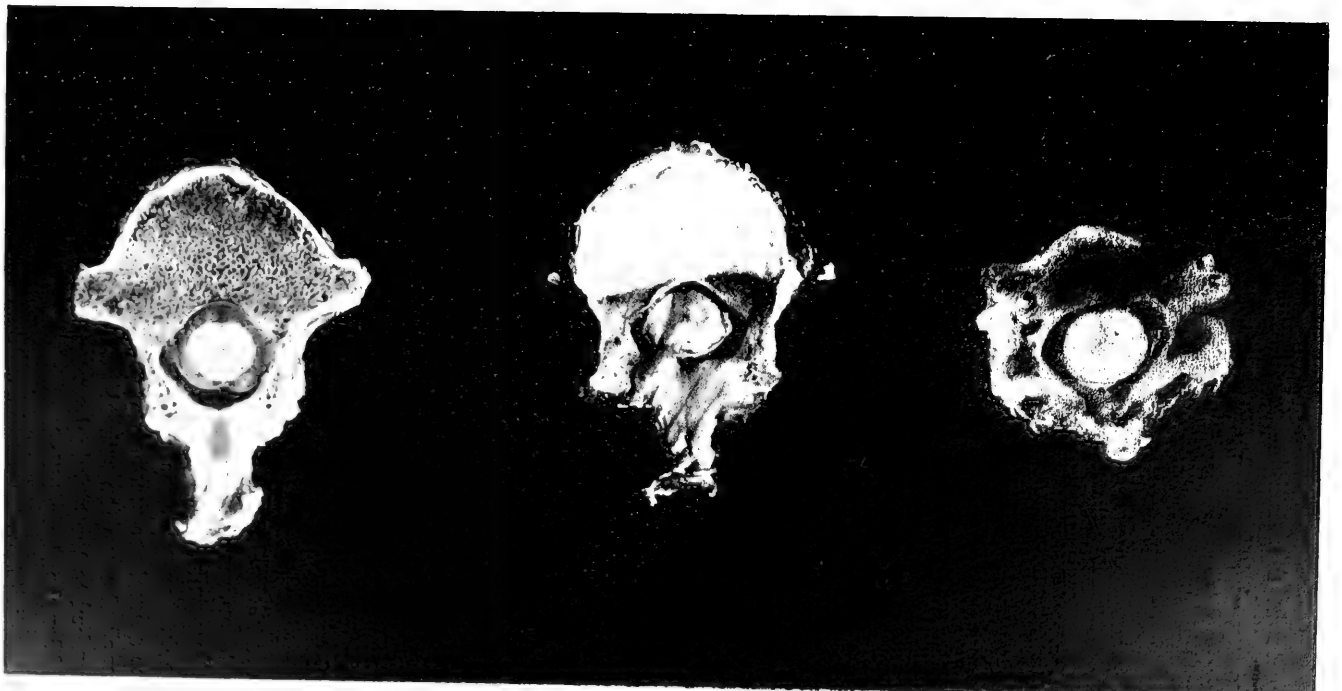


PLATE IV. CASE NO. 8. SECTIONS OF THE VERTEBRA.

The cancellous nature of the bone of the vertebra is well shown in the plate.

frequent in the straight-backed monkeys (see plate 2) as in those which present a normally curved spinal column. The position, already described, which the animal early begins to assume is doubtless largely responsible for this very marked deformity.

The thorax presents some of the most typical malformations. The lower ribs generally become more widely separated, while the upper ones, particularly those to which the pectorals are attached, become bowed in, sometimes forming a peculiar letter S deformity (see plate 3). Ordinarily this causes a throwing forward of the sternum, producing in some cases a typical "pigeon breast" (see plate 3). The points of juncture of the ribs with the costal cartilages become enlarged, causing nodes like those typically seen in rachitis (the "rachitic rosary"). Special types of deformity of the thorax may be seen, depending largely on the physical habits of the particular animal and on the character of the spinal column deformity.

The bones of the lower extremity are usually more or less deformed, ununited fractures may be present, surrounded by uncalcified fibrous callus. As a rule, an outward lateral curvature is presented, but on account of the early paralysis and since the animal very soon learns to support itself on the upper extremities, swinging the body between the arms as in using crutches, the relief of weight from the lower extremities doubtless prevents extreme deformity of the bones. In our opinion the bony changes are inaugurated in the bones of the lower extremities, if we may judge from the symptoms first manifested and from the earliest development of deformity. The ends of all the long bones frequently become enlarged.

Changes in the pelvis are not very marked and, as a rule, the form is fairly well preserved, but, consequent upon deviations of the column, various lateral deflections may be seen. The most frequent deformity, while not really one of the pelvis itself, is the development of an unusually acute angle at the juncture with the lumbar and sacral column.

Deformities in the upper extremities are not usually present, except for increase in size of the epyphyseal ends of the bones and, as a rule, these appear rather late in the disease. This is probably due to the fact that involvement of the upper extremities of the animal are among the very later stages of the disease, and ordinarily before the animal has proceeded so far he has either succumbed to the terminal processes or, having become unfit for exhibition, has been killed.

Deformities of the skull have not been noted by us, although the bones are found extensively softened and thickened.

There is no question in our minds but that the degree of deformity is dependent mostly on the amount of weight or pressure to which the individual bones are subjected, since, in the various parts of the body, all of them are found to show the essential pathological changes in about equal degree, though we believe that they are inaugurated in the lower extremities and spinal column. In the terminal condition any of the bones, even the petrous portion of the temporal bone, may be readily cut with a scalpel without previous decalcification.

As a rule, where secondary injury is not present, the diseased bones present on their external surface very little indication of disease and none of inflammatory reaction. Periostitis occurs, we believe, only from some outside cause and generally the bone is smooth, though the epyphyseal ends appear symmetrically swollen. The animals ordinarily evince little or no pain on pressure of the bone, even to the point of crushing it, for in a large proportion of cases the femurs, for instance, may readily be broken with the fingers. One must remember in this respect, however, that many of these animals do not appear to be very sensitive to pain from any cause.

The gross appearance of the sectioned bone varies greatly. Generally the compact external plates are considerably thinned, the marrow space being considerably increased. As a rule, the outer shell presents a certain amount of lime salts and is still more or less hard, but in some cases, particularly near the epyphyseal ends of the bone, it is found to be soft or semi-elastic, resembling in its physical attributes cartilage more than bone. The periostium shows no notable change in most cases. In the cases of the large flat bones, the entire thickness is transformed into an even greyish semi-cartilaginous material.

The bone marrow also varies greatly in appearance; in places, usually in the shafts of the long bones, it is bright red in color and presents semi-solid areas resembling nodules of cartilage. In the epyphyseal ends, and sometimes throughout the shaft as well, the medulla is represented by a diffuse soft greyish mucoid material in which fine spicules of semi-cartilaginous bone are found representing the normal compact framework of the marrow and cancellous portions. Where cartilage and bone are closely united, as over the head of the femur or between the vertebrae, the marrow seems to have extended into and replaced the cartilage to a large extent. Occasional cystic

cavities are found both in the cancellous portions and in the marrow proper; these spaces are generally filled by a semi-fluid, mucoid or colloid material.

The microscopic alterations vary and apparently without direct relationship in any instances to the special animal or to the circumstance under which the disease developed. Thus in some of our cases, though the animal was young, the alterations are typically those described by Kaufman and others as the *"senile"* type of osteomalacia. This is sometimes associated with what Kaufman also classifies as "Ecte, reine osteomalacia," in so far as we may rest our diagnosis on the microscopic findings in the diseased bone. In our opinion the classification is incorrect and the changes represent but stages in the same process, the marantic or senile type apparently being but a more advanced state.

Some of the bones show an almost complete replacement of the normal marrow tissue by compact masses of cells; small round cells, multinuclear giant cells, and large polymorphous cells, the elongated processes of which form a supporting stroma. Blood vessels, most of them newly formed, are found quite abundantly and about them are seen plasma cells. Extravasations of blood, with resulting disintegration and pigment deposition, are seen commonly. The giant cells are very numerous in places and are so distributed throughout the tissue as to closely resemble the structure of giant-celled sarcoma (see plate 8, Fig. B). As a rule, in these instances the endostium is largely replaced by an incomplete layer of large osteoclasts about which absorption of the compact tissue is obviously taking place (see plate 5, Fig. A). Absorption of lime salts and removal of the organic framework of the bone apparently takes place jointly and at the same time. In many of the cases marked lacunar absorption is also apparent in the compact tissue. In general, no effort toward the formation of new bone or cartilage is to be seen; but occasionally areas are found, notably in the epyphyseal ends, where nodules of a typical cartilage are being formed (see plate 6, Fig. A), but in none is calcification taking place, the processes not even extending on to the formation of osteoid tissue. In some bones, and these we believe to be taken from the more slowly progressive cases or those in which for the time being the disease has been arrested, this abnormal marrow has been replaced by a mucoid tissue (see plate 6, Fig. B), which has occasionally broken down into a fluid, forming the cysts mentioned above. Where marrow destruction is so extreme, as in specimens of this kind, it is difficult to understand how regeneration

of the red corpuscles can take place, hence more or less anaemia must be expected as a direct sequence of these lesions.

Another type of changes found partly in the same skeleton as the above, and also alone in separate cases, comprises the alterations described as typifying true osteomalacia. In these bones lacunar absorption is not apparent, but instead the marrow is limited off from the compact tissue by a relatively normal endostium which encloses no osteoclasts but internal to which is found a layer of osteoid tissue, possessing all the organic structure of normal bone, but from which the lime salts have been removed. Except in this one particular the tissue seems in many ways to be normal (see plate 5, Fig. C). In places, however, the osteoid layer, particularly about the larger Haversian canals, is becoming infiltrated by large polygonal cells, small round cells, and new blood vessels are beginning to form from those originally in the Haversian canal (see plate 7, Figs. A. and B), apparently tending toward the condition noted in the so-called marantic cases.

Vascular System.—Changes in the heart are neither characteristic nor constant. Fatty degeneration of the myocardium is, however, not infrequently found, and in the acute terminal cases parenchymatous alterations may be present.

The arteries also occasionally show fatty degeneration of the intima, as a rule, more pronounced in the larger trunks. Some of the smaller visceral vessels show occasional interstitial increase or arterio-capillary fibrosis; and hyaline degeneration, particularly in the vessels of the brain and cord, is not infrequent.

Digestive Tract.—No changes except a general anaemia have been observed and the clinical manifestations indicated normal digestive function except in the later stages of the disease.

Pancreas and Digestive Glands.—No lesions bearing on the disease have been discovered.

Liver.—More or less pronounced fatty degeneration is usually seen, probably largely the result of chronic congestion which is almost invariably present. Not infrequently perivascular interstitial hyperplasia, sometimes with round-celled infiltration and active interstitial hepatitis, is found.

Respiratory Tract.—Bronchitis is ordinarily present in the middle or later stages of the disease; not infrequently it extends to broncho-pneumonia, which is very often the immediate cause of death in these cases. Chronic congestion of the lungs is also very common. These animals appear particularly prone to tubercular infection, when the process is either most extensive in, or

entirely localized to, the lungs and the adjacent lymph nodes, from which a general infection is very likely to arise.

Spleen and Lymph Nodes.—Congestion and sometimes acute hyperaemia of these structures is present. As a rule, they are more or less enlarged, due to acute or chronic hyperplastic lymphadenitis.

Ductless Glands.—The thyroid gland shows no lesions, it is apparently neither increased nor diminished in size. The thymus body shows no variations from the normal. The adrenal glands frequently show congestion, with slight fatty degeneration of the cortical cells.

Urinary Tract.—The kidney ordinarily shows more or less congestion with fatty and parenchymatous degeneration and occasionally slight interstitial nephritis. The bladder exhibits no alterations and we have never found it to contain calcareous deposit, as has been reported in occasional cases in man (Dock, American Journal of Medical Sciences, p. 499, 1895). We have not, as yet, studied the urine in these cases.

Genital Glands.—The disease has been found, in our cases, most frequent in males, even those presenting the osseous lesions supposed to be characteristic of "true osteomalacia," and we are therefore unable to state as to the relationship between the ovaries and osteomalacia in the primates, though the bearing of the puerperal state and the development of the disease in man seems to be well established. It is noteworthy that the primates chiefly affected rarely reproduce in captivity or show any marked sexual proclivities. In so far as we have investigated the disease, there seems to be no pathological changes present in the genital glands of either sex.

Central Nervous System.—Changes in the central nervous system are constant in the well-developed stages of the disease and the symptoms arising from this involvement of the brain and spinal cord are among the most characteristic of the conditions, tending to overshadow the osseous alterations. Probably for this reason the condition has been commonly looked upon as a primary disease of the central nervous system and it was along these lines that we first undertook the study of the malady. In the light of more recent observation it appears to us that the osseous lesions precede those of the central nervous organs, which are probably secondary, though we must not forget that some observers still look upon the osteomalacia as a tropho-neurosis (Fehling; see Mallard, "Osteomalacie à forme nerveuse." Bul. Soc. méd. d. hop. de Lyon, 1903, 11). It does not appear at all strange that

the disease should have been so long considered as one primarily of the nervous organs, since in the study of these animals it is often impossible to properly inspect or palpate them, and we are more dependent on the study of the movements of the animals. From simple observation alone, one cannot fail to be impressed with the idea that the disease is chiefly a muscular or nervous disorder, and it is only when we are able to closely inspect the animals that the earlier changes in the bones with their deformities can be made out. In reviewing the literature of osteomalacia as it occurs in man, we have been struck with the meagre account of the nervous lesions which accompany the disease in the human, probably because the prominence of the osseous changes has overshadowed them. Many otherwise careful descriptions of the disease entirely omit this important system.

It is probable that the malnutrition and anaemia which accompany the disease are largely responsible for the lesions of the central nervous organs, but these alone, to our minds, do not satisfactorily explain all the changes which we have found in the brain and spinal cord. Doubtless the deformity of the spinal column with pressure on the cord, posterior root ganglia and nerve roots, causes certain of the lesions, but in our opinion there is a still more close relationship existing between the disease and these alterations which may be directly and independently produced by the essential etiological factors. We are as yet unable to give a plausible explanation of this relationship. It seems to us most likely the changes develop secondarily or after the bony lesions are comparatively well advanced, since in one instance, one of the earliest cases studied by us (case X) no degenerative alterations of the spinal cord were found. Again the great variation in the affected tracts noted in our cases would apparently indicate that the disease was not a primary or specific one of the central nervous system for the lesions are not constant but variable.

The alterations found in the brain consist of chromolitic changes in the ganglion cells, and of a dilatation of the lymph spaces associated with more or less congestion of the cerebral vessels. The degenerative factors seem to have a particular selection for the cells of the motor cortex, if we may judge from the changes found in the spinal cord.

In the cord the most common lesions noted by us have been degenerations of various tracts, most constantly of the direct and cross pyramidal tracts; also the columns of Gall and Burdach (see case reports). Lesions simulating those of poliomyelitis

have been seen, and in general changes like those found in the brain. The blood-vessels of the cord, almost without exception, show pronounced alterations, and it is highly probable that these are in a large degree responsible for certain of the degenerated cells and fibers. The posterior root ganglia have been found to show diseased ganglion cells in some of the cases with a consequent degeneration of the posterior nerve roots. The anterior nerve roots have also occasionally presented degenerated fibers.

In concluding this summary of the changes found in the central nervous system, we feel that we can do no better than to quote from the conclusions presented in our study concerning cage paralysis in last year's report:

"It seems evident that 'cage paralysis' as noted by animal men is not a true disease entity, but that it covers many types of paralysis, mostly of spinal origin and probably as numerous as the like conditions in man.

"From the five cases outlined in this study it seems that the lesions very closely resemble those of similar and well-recognized human diseases."

PROGNOSIS.

This condition can never be accounted less than serious. While a case in its very earliest stage is much more hopeful than one that is far advanced, with bones extensively softened, yet the prognosis as to recovery is always bad. In the earlier and more favorable cases, the disease may apparently be arrested. From the foregoing pathological lesions it is hardly to be expected that healing and regeneration of the extensively altered bones, or of the degenerated nerve tissues, can take place.

TREATMENT.

In respect to the treatment to be recommended and instituted, we are of the belief that this can only be employed, with any rational hope of benefit, during the period of incubation, and with the anticipatory purpose of prevention. It is but seldom, however, that the necessary advantage of this early knowledge of the disease is secured, and when the true nature of the trouble has become apparent it is often too late to resort to the remedial measures which might have been employed in the early stages. We are using freely bone-dust and lime-water in the food and water of our cases. These substances being practically odorless

and tasteless, are readily partaken of by the animals. When the morbid process of the disease was active, these remedies have been useless. While these substances may act as a specific remedy, they certainly have a distinctively tonic effect in the cases in which we have used them. However, our experience, as yet, is too limited to justify a too hopeful expectation from these measures. Everything possible should be done to improve the general health; sunlight, dry and well-ventilated quarters are absolutely essential. A varied, as well as a nutritious diet, is very important. Care should be taken to select food containing a relatively proper adjustment of both organic and inorganic food elements.

DURATION.

The disease is nearly always continuously progressive, but we have observed several cases which were subject to at least temporary cessation, covering a period of several months. It may assume an acute or a chronic form. In the former case three to four months is the average, while mildly progressing forms may extend over a period of several years before a fatal termination.

CASE I.

Barbary Ape (*Macacus innus*).—The animal had been some time in captivity or on ship-board before being delivered to the Park.

On its arrival with a consignment of other animals the veterinarian at once noted the condition of paralysis, which seemed to be fairly typical of the picture usually presented in "cage paralysis." The animal was also found to be tubercular, hence was never placed on exhibition but was kept in the quarantine station up to the time of its death.

POST-MORTEM EXAMINATION.

Examination made on date of death.

Body.—Markedly emaciated, tissues very anæmic. *Heart*—Collapsed, flabby; otherwise apparently normal. *Lungs*.—Both lungs filled with caseous tubercular masses varying in size from a pea to a walnut. There is a small area of recent hæmorrhage in the right middle lobe. *Liver*.—Vessels congested, a few scattered tubercles are present. *Kidneys*.—Both are studded with tubercles and the parenchyma shows a general parenchymatous nephri-

tis. *Spleen and Lymph Nodes.*—Both are much congested and are extensively tubercular. *Stomach.*—Empty except for a small amount of yellowish fluid, no food is present. *Intestine and Genito-Urinary Tract.*—Negative. *Brain and Spinal Cord.*—Gross examination of the spinal cord after it has been hardened, showed meningitis, most intense at lower levels.

MICROSCOPIC EXAMINATION.

Cervical Cord.—In the upper cervical levels the pia-arachnoid shows a moderate degree of chronic thickening of the membranes, and in places the connective tissue cells of its structure show evidences of recent proliferation, particularly about the vessels, which are quite universally injected. In the lower cervical regions the membrane shows in addition a very marked serous exudate, which in places contains a good many leucocytes, chiefly mononuclear cells, but in places there are a good many polynuclear ones. The cellular exudate is most apparent about the blood vessels, which are mostly congested.

The substance of the cord shows a very general dilatation of the lymph channels, particularly of the perivascular spaces, and in some places the lacunæ in which the cells are lodged are also dilated, this without apparent shrinkage of the ganglion cells.

The vessels of the cord are injected and a few of them show a slight exudate of small round cells into the adventitia.

Sections compared after the Marchii method show occasional degenerated fibers, chiefly in the posterior tracts and most numerous in the column of Goll. Occasional degenerated fibers are also found in the descending tracts, but nothing like a systematic degeneration is evident in them.

Sections stained with the Neisl blue, show a very general disintegration of the chromatic plaques of the ganglion cells, some of them are still evident but show lack of staining affinity, others show a finely granular disintegration of the plaques. These evidences of degeneration are very general and in some places amount to actual cytoclasis; it is more than probable that many of the alterations are of post-mortem origin.

Dorsal Segments.—Series of sections taken in the upper, mid and lower dorsal segments show alterations very like those described in the cervical region, except that the lesions increase in intensity as the lower levels are reached and, though altogether similar to those described in the cervical regions, are of much

more marked degree. In the lowest dorsal segments the cellular exudate is found passing into the cord with nerve roots.

Lumbar Cord.—In some places the meningeal exudate has so infiltrated the cord that practically a condition of transverse myelitis exists, otherwise the lesions are like those of the superior portions of the cord.

Cauda Equina.—Sections show a very marked general small round-cell exudation about all the nerve fibers. Well-formed tubercles are frequent and in some cases have caused complete necrosis of the normal structures.

Posterior Root Ganglia.—Sections of the posterior root ganglia of the lower levels show also an intense productive inflammation apparently following the nerve trunks. Degenerated nerve fibers are not numerous even in those of the *cauda equina*, and from the condition of the ganglion cells it seems highly probable that at least a part of the degenerated fibers are due to a disease of the ganglion cells.

Conclusion.—The condition clearly originated as a tubercular meningitis and the disease apparently started in the lower portion of the spinal canal, extending rapidly upward.

Case II.

Common Macaque (*Macacus rhesus*).—This animal formed one of a large group of these monkeys and was not particularly observed, except that the case was rapidly progressive.

The wasting of the muscles of the rear extremities was moderately well marked and paralysis of the extremities was complete when the animal was killed. No trophic ulcers had developed and the body was not extremely emaciated, for the animal had continued to take its food fairly well, though not so anxiously as a normal one would.

The gross examination of the cord and brain showed nothing of note, and the internal viscera were normal, except for a general deficiency in fat.

Microscopic examination.

Brain.—Sections taken through the left motor cortex showed nothing noteworthy, except a general dilatation of the lymph spaces. No degenerated fibers are present in either the sub-cortical white matter or in the left internal capsule. *Cord.*—The membranes of the cord are normal.

Medulla.—Sections prepared by the Busch-Marchii method

show no degenerated fibers in the pyramids, but a few are present among the arcuate fibers and in the neighborhood of the nucleus gracilis and cuneatus. A few degenerated fibers are also present in the fillet. There is general dilatation of the lymph spaces.

Cervical Cord.—The lymph spaces are generally dilated, but otherwise the general structure is not altered. Sections prepared by the Busch-Marchii method show a great many degenerated fibers in the posterior tracts, particularly in the column of Goll. The most radial fibers in Burdach's tract do not seem to be affected. There is also a marked general degeneration in the fibers of the direct cerebellar tract and a few scattering degenerated fibers in the antero-lateral tract, also an occasional one in the direct pyramidal and in the anterior ground bundle.

Sections stained by the method of Neisl show a general chromatolysis in the cells of the anterior horns; the alteration is so general that it is likely largely due to post-mortem changes.

Dorsal Cord.—Sections through the upper dorsal levels show alterations similar to those found in the cervical segments as regards the degenerated tracts, except that the column of Burdach is relatively more involved.

The mid-dorsal region presents an area of myelitic softening in which all the structures of the cord are extensively necrosed and the entire mass is permeated by extravasated blood mingled with broken-down masses of myeline.

The lower dorsal segments show extensive degeneration of the direct and crossed pyramidal tracts and numerous degenerated fibers in the anterio-lateral and the anterior ground bundle; a few scattering degenerated fibers are also present in the posterior tracts, but these columns are in general free from degenerations. The blood vessels in the grey matter are quite extensively congested and areas of myelitic degeneration are frequent.

Lumbar and Sacral Cord.—The degenerations present are almost exclusively limited to the descending columns.

Posterior Root Ganglia.—No alterations are evident above the level of myelitis. Ganglia corresponding to the area of softening show a few small patches of cellular exudation and a shrinkage of some of the ganglion cells.

Blood Vessels.—The blood vessels throughout the spinal cord, with the exception of the area of softening, show no apparent changes.

The case is clearly one of transverse myelitis of the mid-dorsal cord with the descending degenerations below the lesion and the

usual ascending degeneration above. Aside from this the cord seems to have been normal and the cause of the myelitis is not apparent.

CASE III.

Vervet Monkey (*Cercopithecus lalandii*).—The animal presented the general clinical manifestations of cage paralysis. Six weeks elapsed between the time of the first observation of the disease and the death of the animal. During this period the monkey emaciated moderately and progressive atrophy of the rear extremities have become marked.

The autopsy, which was performed by Dr. Blair, showed moderate general emaciation with marked atrophy of the hind extremities from the pelvis down. There was a large deep indolent appearing ulceration of the tissues over each tuberosity of the *ischium*. The *heart* was in diastole and normal. The *lungs* were normal. The *liver* was congested. The *kidneys* were moderately congested. The *bladder* was well filled with urine and was otherwise normal. The *stomach, pancreas* and *intestines* were normal throughout. *Brain and Spinal Cord.*—Gross examination shows no lesions in either brain or cord.

MICROSCOPIC EXAMINATION.

Cervical Cord.—Microscopically, the spinal cord in the cervical region shows a considerable number of degenerated fibers in the direct and crossed pyramidal tracts and in the antero-lateral tracts. Degenerated fibers are also found in the anterior nerve roots. Examination of the ganglion cells of the anterior horns shows very marked atrophy, in many cases amounting to actual cytoclasis. Others of the cells are elongated, the chromatic plaques are missing and the cells show atrophy to a marked degree.

Dorsal Cord.—The descending degeneration present in the cervical segments is also present in the dorsal cord, and in addition occasional degenerated fibers are present in the columns of Goll and Burdach. The ganglion cells of the anterior horn in these levels show also the same marked degeneration as was found in the cervical regions, but the degenerated cells are much more numerous here than in the cervical levels. Sections of some of the posterior root ganglia from these levels show atrophy of certain cells, together with the degeneration of some of the fibers originating in the ganglia. The nerve trunks surrounding the cord show a good many degenerated fibers.

The blood vessels show no abnormality except in those areas of the anterior horns where the degenerated cells appear most frequent; here there seems to be perivascular gliomatosis of slight degree.

Lumbar Cord.—Alterations in the lumbar cord do not differ from those found in the cervical and dorsal levels.

Conclusions.—A descending degeneration with poliomyelitis is disseminated throughout the cord, becoming more marked in the lower levels where the posterior root ganglia are also involved, causing degeneration of isolated fibers in the ascending tracts.

It is a little difficult to reconcile the degenerations found in this cord without assuming some disease of the encephalon, and in all probability this was present. It is probable, however, that the lesions that gave rise to the most marked symptoms were the poliomyelitic changes.

Case iv.

Macacus nemestrinus.—The animal exhibited the atrophies in a moderate degree, and the disease was of rather recent onset. The animal was killed by chloroform and the general post-mortem examination showed nothing of note. No gross alterations were evident in the brain or cord.

Microscopically, the lesions present throughout the cord consisted of an atrophy and degeneration of the cells of the anterior horn, particularly in the lower dorsal and lumbar regions, but present also, though in lesser degree, in the cervical levels.

Occasional degenerated fibers were found, scattered irregularly throughout the ascending as well as descending tracts, but no definite systematic degeneration was present.

Vascular alterations, chiefly an acute exudative arteritis, was present in the anterior horns in a few patches, and elsewhere many of the smaller vessels showed a chronic proliferative arteritis; the larger vessels seem to be free from these changes.

Conclusions.—This case apparently represents one of poliomyelitis of rather recent origin associated with a chronic proliferative arteritis of the smaller vessels of the cord.

Case v.

Golden Baboon (Papio babuin).—This animal presented the typical clinical manifestations of "cage paralysis." Its case was a mildly progressing one, extending over a period of two years, before terminating fatally. At times the animal suffered from

bronchitis, its general condition, however, remained good. It did not attempt to climb about the cage, but sat on the floor constantly, generally with the hind limbs flexed.

POST-MORTEM SUMMARY.

Body.—Fairly well nourished. *Heart.*—Diastole, normal. *Lungs.*—Show acute broncho-pneumonia. *Liver.*—Congested. *Kidneys.*—Congested. *Spleen and Lymph Nodes.*—Congested. *Stomach.*—Contains no food; anaemic. *Intestines.*—Normal. *Genito-Urinary Tract.*—Negative. *Osseous System.*—Sternum and ribs showed extensive changes. They were much deformed and almost entirely cartilaginous; considerable lateral curvature of the spinal column, especially in the mid-dorsal and lumbar regions. The vertebrae easily cut through and showed large cancellar cavities and intense congestion.

CASE VI.

Sapajou (*Cebus hypoleucus*).—This animal was in poor health at the time of entrance, and was only on exhibition a very short time when symptoms of "cage paralysis" were noted. The case was one that might be classed as *acute*. About eight weeks elapsed from observation of first symptoms till death.

POST-MORTEM SUMMARY.

Body.—Poorly nourished and marked atrophy, especially of posterior extremities. *Heart.*—In systole and normal. *Lungs.* Pigmented; otherwise normal. *Liver.*—Chronic congestion. *Kidneys.*—Congested. *Stomach.*—Empty; catarrhal and anaemic mucosa. *Intestines.*—Catarrhal enteritis. *Genito-Urinary Tract.*—Normal. *Osseous System.*—General degeneration. Long bones decalcified, soft and easily fractured. Ribs and sternum almost entirely cartilaginous and considerably distorted, especially sternum and ribs.

CASE VII.

Sapajou (*Cebus hypoleucus*).—This animal had been on exhibition only a few months when it showed the first characteristic symptoms of "cage paralysis." The disease ran a rapid and con-

tinuously progressive course, terminating fatally in about ten weeks from the time the first symptoms were noted. Reflexes totally absent from posterior extremities.

POST-MORTEM SUMMARY.

Body.—Shows marked emaciation. *Heart.*—Diastole, normal. *Lungs.*—Slight bronchial catarrh. *Liver.*—Congested. *Kidneys.*—Congested. *Spleen and Lymph Nodes.*—Marked anaemia. *Stomach and Intestines.*—Show marked anaemia. *Genito-Urinary Tract.*—Negative. *Osseous System.*—Generalized decalcification. All long bones fracture under slight strain. Vertebrae soft and easily cut through with scalpel. Ribs and sternum almost entirely cartilaginous.

CASE VIII.

Golden Baboon (Papio babuin).—This animal had been on exhibition about two years before symptoms of "cage paralysis" were manifested. Its case covered a period of about six months. Emaciation, mildly progressive. Persistent bronchial cough.

POST-MORTEM SUMMARY.

Body.—Poorly nourished; superficial ulcerations at base of the tail and over the point of the *ischium*. *Heart.*—Fatty, soft and flabby. *Lungs.*—Bronchitis; heavily oedematous throughout. *Liver.*—Congested. *Kidneys.*—Congested; parenchymatous nephritis. *Spleen and Lymph Nodes.*—Anaemic. *Stomach and Intestines.*—Normal. *Genito-Urinary Tract.*—Negative. *Osseous System.*—All bones show advanced degeneration. Long bones easily fractured. Thorax greatly distorted, compressed laterally and cavity diminished considerably.

MICROSCOPIC EXAMINATION.

Cervical Cord.—The membranes of the cord show a light thickening, but no inflammatory exudate is demonstrable. The vessels of the membranes are generally thickened and are filled with blood cells, a few show slight haemorrhage by diapedesis.

The general structure of the cord is not altered, but the lymph spaces are notably distended and the blood vessels congested. The walls of the blood vessels show quite a general hyaline degenera-

tion and a few of them are surrounded by an area in which the neuroglia is somewhat thickened. A few of the larger lymph spaces are surrounded by narrow zones in which a granular necrosis is present. The ganglion cells of the anterior horns show many evidences of degeneration, some of them are atrophic and more or less distorted, others show a simple deposition of coarse granules in their cytoplasm, while still others show only slight disintegration of the chromophilic plaques, no constant alteration is present, and doubtless at least a part of the changes are of post-mortem origin. Sections stained by the modified Marchii method show many degenerated fibers in the posterior columns, particularly in the column of Goll, in the anterior ground bundle and a few isolated degenerated fibers in the direct pyramidal tracts.

Dorsal Cord.—Changes exactly similar to those described in the cervical cord are present, except that the column of Burdach is more involved in these levels and that relatively fewer degenerated fibers are seen in the anterior pyramids.

Lumbar and Sacral Cord.—General alterations like those of the upper segments are demonstrable, but degenerated fibers are relatively infrequent in the small posterior columns and are found only widely separated and in small number in the anterior columns.

Cauda Equina.—The vessels of these nerve trunks show quite extensive hyaline degeneration and some of the trunks show an increase in the amount of endoneurium. Degenerated fibers are scattered throughout in small numbers, and are not confined to any particular trunks, they are not so numerous as in the trunks surrounding the lower dorsal segments, where many degenerated fibers were demonstrated.

Bones.—Sections taken through the head of the greatly softened femur show remarkable alterations. The layer of hyaline cartilage surrounding the bone is thickened and is found to be very highly cellular, much more so than normal except in the early stage of cartilage formation. As many as twelve cells may be found in a single lacuna and the arrangement into columns is disrupted. The blending into osseous tissue takes place in a very irregular line and at a generally deeper level than in the normal bone, and, even in the centers of the bony islands, areas of cartilaginous metaplasia are shown, while the borders of the bony spicules are blended with mucoid or cartilaginous tissue and occasional osteoclasts are scattered along them. In the greater part of the head of the bone, circular or oval areas of chondrification are found, the outer borders of which present radiating columns

of cartilage cells, while the centers are made up of diffuse hyaline tissue containing only occasional cells, a few fibers and an occasional spicule of incompletely calcified tissue (plate 6, Fig. A). Many of the cartilage cells in these areas show karyokinetic figures and cell division is evidently actively taking place. The spaces of the cancellous portion of the bone are for the greater part completely occupied by mucoid tissue, in places containing few cells mostly resembling embryonic connective tissue cells, with a few scattering leucocytes and plasma cells (plate 6, Fig. B). In other places the homogenous matrix of mucoid tissue is densely infiltrated with cells of many types, polynuclear leucocytes, many of which are eosinophiles, normoblasts, megaloblasts, osteoclasts, of particularly large size, and small round cells with occasional plasma cells. These cellular areas are particularly frequent about the walls of the blood vessels. Newly formed blood vessels are frequent. Pigmentation, as from broken-down red blood cells, is found in a few areas where apparently small extravasations from the new vessels has taken place.

In the preparation of this bone for microscopic examination but slight decalcification was necessary, and before this was begun the bone could be easily compressed between the fingers.

Case IX.

Diana Monkey (Cercopithecus diana).—In this case the paralysis of the posterior extremities was early manifested. Animal continued to take its food well up to within day of death. Superficial ulcerations developed on several parts of hind limbs. Emaciation or atrophy not excessive in this case.

POST-MORTEM SUMMARY.

Body.—Moderately emaciated. *Heart.*—Systole, normal. *Lungs.*—Bronchitis. *Liver.*—Congested. *Kidneys.*—Congested. *Spleen and Lymph Nodes.*—Anaemic. *Stomach and Intestines.*—Contained considerable partially digested food; mucous membranes anaemic. *Genito-Urinary Tract.*—Negative. *Osseous System.*—Marked changes in all the bones. Soft and easily broken. Thorax and pelvis greatly distorted. Vertebrae easily cut.

Membranes.—Both the dura mater and the pia are thickened throughout their entire course, the thickening being in adult con-

nective tissue. The vessels of the membranes show a general congestion and a few minute haemorrhages are present, but no cellular exudation or other evidence of acute inflammatory processes is present, except for a considerable amount of clear serous effusion between the membranes. The walls of the meningeal vessels, in some cases, show a moderate degree of hyaline degeneration.

Cervical Cord.—The general structure shows no change but the lymphatic spaces are much distended, particularly about the vessels and the larger ganglion cells. The blood vessels show a very general periarteritis, the hyperplastic tissue of the adventitia being highly cellular. The intima in most instances is also thickened and a few of the vessels show proliferation of the endothelium. Occasional areas of granular necrosis are present, most commonly about the larger lymph spaces and affecting both gray and white matter. The ganglion cells of the anterior horns show degenerative alterations, the most frequent of which is eccentricity of the nucleus with granular degeneration of the cytoplasm. Other cells appear perfectly normal, while some are atrophied and distorted. A good many cells contain many perinuclear granules which stain black with osmic acid. Sections prepared by the osmic acid method show degenerated fibers in large numbers in the posterior columns, mostly in the column of Goll, in the peripheral portions of the lateral columns and in small numbers in the cross pyramidal, direct pyramidal and the anterior ground bundle. Degenerated fibers are also demonstrable in the posterior nerve roots in very small numbers, but none can be found in the anterior nerve roots in these levels.

Dorsal Cord.—The alterations are like those of the cervical cord, but the degenerated fibers occupy a relatively larger part of the posterior columns and the anterior and lateral portions of these levels are much less affected, while the degenerated fibers are more widely separated.

Lumbar and Sacral Cord.—Changes like those described above are present throughout, but relatively fewer fibers are degenerated, and those found are chiefly demonstrable in the lateral columns and in the outer parts of the posterior tracts.

Bone.—Body of dorsal vertebra. The block required but very slight decalcification and could be easily cut with an ordinary scalpel before this was done.

The periostium shows a general thickening in adult fibers and the connective tissue cells are abnormally numerous, but it does not present the picture of an active proliferative process. No

osteoclasts could be demonstrated and the osteogenitic layer of the periostium cannot be clearly differentiated.

The compact portions of the bone are made up of a frail network of thin plates and spicules, and in many of these narrow septs the Haversian canal is occupied by tissue similar to that to be described as occupying the cancellous crypts. These spaces are filled, to the exclusion of fat, by a dense mass of cells, the integers of which are for the greater part mononuclear cells resembling lymphocytes; with these are associated polynuclear leucocytes, among which eosinophiles are very common; red blood cells, largely nucleated; plasma cells and large polymorphous cells which have long slender processes that apparently make up the chief framework of the tissue. The endostium is entirely wanting in many places; in a few others it is represented by a nearly normal, though highly cellular membrane, but, as a rule, the calcareous tissue changes directly into the marrow pulp or to a layer of large cubical, or polygonal, cells, among which are frequent larger polynuclear osteoclasts (plate 5, Fig. A). Thin walled blood vessels are very numerous in the cellular pulp, and blood cells, both nucleated and nonnucleated, are scattered throughout. In a good many areas masses of brown pigment are found, evidently resulting from the breaking down of blood. Giant cells are very numerous throughout this pulp and the cytoplasm of some of them appear to contain calcareous granules. The general appearance of this pulp, the stoma of which is very scant, resembles almost identically a giant celled sarcoma.

Case x.

Macaque (Macacus cynomolgus).—This was a mildly progressing case of "cage paralysis," extending over a period of one year. Only at the late stage of the disease were emaciation and atrophy of hind limbs marked features.

POST-MORTEM SUMMARY.

Body.—Shows marked atrophy; curvature of spine. *Heart.*—Diastole, normal. *Lungs.*—Pigmented; otherwise normal. *Liver.*—Congested. *Kidneys.*—Congested. *Spleen and Lymph Nodes.*—Congested. *Stomach and Intestines.*—Anaemic. *Genito-Urinary Tract.*—Negative. *Osseous System.*—All bones show general softening. Thorax laterally compressed. Ribs almost en-

tirely cartilaginous. *Lumbar vertebrae* enlarged, softened, and showing quite extensive anterior curvature.

Blood Examination (specimen taken from ear, just before animal was killed).—Haemoglobin 65 per cent (Dare). On drawing the blood it was found to be abnormally light in color and to flow very slowly, being of a somewhat gelatinous consistency like the blood in leuchaemia. It clotted rapidly, but the resulting clot was not so firm and compact as normal.

The red cells are found to vary greatly in size, many microcytes and macrocytes being present. Poikilocytes are numerous, but no degenerated cells were found. A few normoblasts were found and a few megaloblasts. Blood plates are very numerous. Leucocytes are found to be relatively very frequent, a few of them are pigmented, and one very large mononuclear leucocyte was found. The differential leucocyte count shows:

Polynuclear neutrophiles	67.0	per	cent.
Lymphocytes	27.5	"	"
Mononuclears	0.5	"	"
Transitionals	3.0	"	"
Eosinophiles	1.0	"	"
Basophiles	1.0	"	"

The granules in the eosinophilic cells are notably smaller than in man, otherwise the cells do not appear to differ much from those found in the human.

Bone Marrow (Smear).—Many abnormal cells are present. Giant cells, for the greater part polynuclear, with eosinophilic granulation are numerous. In some of them a typical karyokinesis is demonstrable while large megaloblasts showing almost any stage of karyokinesis are not infrequent. Dividing normoblasts are common. Notable is the large number of leucocytes with basophilic granulation, the granules being notably smaller than in man. Phagocytic cells, leucocytes and giant cells are very common. Many of the erythrocytes present show very extreme degenerative alterations and free pigment granules are commonly found.

MICROSCOPIC EXAMINATION.

Cervical Cord.—The membranes of the cord show nothing abnormal. There is slight irritation of the perivascular and pericellular lymph spaces and some of them contain slight exudation of small round cells. The ganglion cells of the anterior horns show no alteration. Segments prepared by the Busch modifica-

tion of the Marchii method show no degenerated fibers either in the columns of the cord or in the surrounding nerve trunks.

Dorsal Cord.—The same changes noted in the cervical cord are also present in the dorsal segments. A few of the ganglion cells show, however, an abnormal brownish pigmentation. No degenerated fibers are demonstrable by the Busch method.

Lumbar and Sacral Cords.—Changes similar to those described above are present. The entire spinal cord as represented by these sections may be said to be practically normal.

Spleen.—The blood vessels are markedly congested throughout and there is a general extravasation of red blood cells through the splenic pulp. The Malpighian bodies show many evidences of acute lymphoid hyperplasia. Extensive areas of pigmentation are present in places, apparently resulting from the breaking down of many red blood cells.

Bone.—Shaft of femur.—The fatty tissue of the marrow is largely replaced by dense masses of mononuclear and polynuclear leucocytes, fibroblastic and plasma cells, among which are found frequent multinuclear and mononuclear giant cells. Evidences of karyokinetic division are frequent among these cells, but in places fibroblastic cells predominate and a mucoid-like tissue is found replacing the marrow. Osteoclasts are found abundantly at the juncture with the compact tissue and these cells have largely replaced the endostium and, in places, are evidently causing active resorption of the osseous tissue. Some of the larger Haversian canals in the compact bone are surrounded by osteoid tissue from which the lime salts have evidently been removed leaving the general structure very similar to that of normal bone with the exception that the bone cells have become considerably altered, being larger, more numerous, and presenting evidences of reproduction. Osteoclasts are absent, except in the larger of these spaces, and the process does not seem to be primarily lacunar absorption.

Case xi.

Sapajou (Cebus hypoleucus).—This animal had been in captivity several years before being deposited at the Park. Paralysis was not a feature of this case and reflexes were present in the hind limbs. On palpation a considerable alteration in the shape of thorax and especially of the sternum was found. The animal was killed in the early stage of the disease, which probably accounts for the absence of anesthesias of the posterior extremities.

POST-MORTEM SUMMARY.

Body.—Shows marked emaciation. *Heart.*—Normal. *Lungs.*—Bronchitis. *Liver.*—Congested. *Kidneys.*—Congested. *Spleen and Lymph Nodes.*—Anaemic. *Stomach and Intestines.*—Contained considerable partially digested food. Mucous membranes, anaemic. *Osseous System.*—All the bones softened, easily fractured. The long bones consisting of a thin rim of compact tissue, containing thin gelatinous blood-stained marrow.

Blood Examination made immediately before death.—The blood presented less gross changes than in the previous case, clotted more naturally and was less gelatinous in character. Haemoglobin determined by the Dare instrument showed 74 per cent.

The size of the red cells varies considerably, both macrocytes and microcytes being present. Poikilocytosis is marked, but the relative amount of haemoglobin staining is about natural. Megaloblasts and large mononuclear leucocytes, occasionally showing cell division, are to be found in considerable frequency, and a few normoblasts are also present. No cells showing cytoplasmic degeneration were found.

A few pigmented leucocytes, both lymphocytes and polynuclears, were found. The differential leucocyte count shows the following:

Polynuclear neutrophiles	56.5	per cent.
Lymphocytes	35.0	" "
Mononuclears	2.5	" "
Basophiles	0.5	" "
Eosinophiles	4.5	" "
Transitionals	1.0	" "

Cervical Cord.—Membranes of cord, negative. Dilatation of the lymphatic channels, particularly of the perivascular and pericellular spaces. Some of the blood vessels show slight hyaline degeneration. The ganglion cells of the anterior horns show nothing abnormal.

Scattered degenerated fibers are present throughout the entire transverse section of the cords. They are widely separated and are apparently no more abundant in one column than in another. Collectively they are very few, as compared with the normal medullated fibers.

Dorsal, Lumbar and Sacral Cord.—The changes throughout these levels are similar to those present in the cervical cord.

Spleen.—The blood vessels throughout are markedly congested

and extravasations of red cells into the splenic pulp are present, in greater or less degree, throughout the entire tissue. Extensive destruction of these cells is taking place and pigmentation resulting from this disintegration is general throughout. The Malpighian bodies in this species appear to be very small, but in places they have been encroached upon by a chronic perarteritis.

Bone.—Shaft of Femur. The marrow is completely replaced by a dense mass of cells, among which mononuclears and epithelioid cells appear most frequently. Polynuclear leucocytes, fibroblasts single and multinucleated giant cells are also frequent. Normoblasts are found in but relatively small number and extensive destruction of blood cells appears to be taking place, as evidenced by the presence of phagocytic endothelioid cells, the cytoplasm of which is literally crammed with broken down red cells. The endostium is intact in most places, but in other areas is largely replaced by groups of osteoclasts which are evidently causing absorption of the adjacent compact tissue. The Haversian canals of the compact bone are surrounded by broad zones of homogeneous osteoid tissue which is limited from the compact bone by a fibrous band resembling endostium. Extravasation of red blood cells into this tissue is present in places, but in other areas it is strictly osteoid in character, though, as a rule, the Haversian vessels in the larger areas are surrounded by cellular tissue resembling that of the marrow. A few of these spaces show an apparent cartilaginous formation resulting in replacement of the vessels and normal tissue. Not infrequently the blood vessels appear to be plugged by hyaline thrombi.

CONCLUSION.

We by no means consider this presentation of osteomalacia, as it occurs in the Primates, conclusive or final. The question is of the greatest possible importance to Zoological societies, and until some definite means of prevention can be devised, the subject can be looked upon as little more than opened. It is, therefore, our purpose in the future to study particularly the genesis of the disease and its treatment. For this reason it is first imperative that an especially careful study of the urine in the malady be made, particularly as to its increase in content of bone salts and as to the presence or absence of lactic acid in both urine and blood. We also propose to thoroughly investigate the condition as affected by the administration of the extracts of the ductless glands, notably those of the thyroid and adrenal.

The relationship of food to the development of osteomalacia must be fully entered into, as well as the effects of ordinary hygenic measures.

The truly remarkable success attained in the treatment of the puerpural forms by castration in man, indicates the possibility of securing some beneficial results by this method in animals also.

Perhaps of even greater importance, however, is the direct bearing, which study of this condition in the primates, the species most closely related to man, may have on the understanding of the whole subject of osteomalacea, particularly since it is here possible to undertake problems in experimental investigation, especially along the lines of therapeusis, of immediate bearing and value to human medicine, methods which may not be justifiable to first attempt on man and which, on account of great variation on species status are of uncertain value when conducted with domestic or the ordinary laboratory animals.

In conclusion we may summarize the result of our study as follows: "Cage paralysis," as seen in Primates in captivity, is osteomalacia. The differentiation of some authors into senile, marantic and true osteomalacia does not hold in the monkeys.

The disease is very frequent in monkeys in captivity, but probably does not occur in the wild (Hornaday, Report New York Zoological Society, 1903, p. 116).

The disease as it appears in Primates is chiefly characterized by decalcification of the bones, but degenerative lesions of the central nervous organs are, though probably secondary, an essential manifestation of the disease.

The etiology is unknown.

PLATE V.

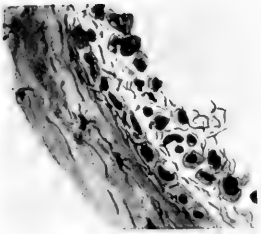


FIG. A.—Case No. 9, Osteoclasts causing absorption of compact bone.

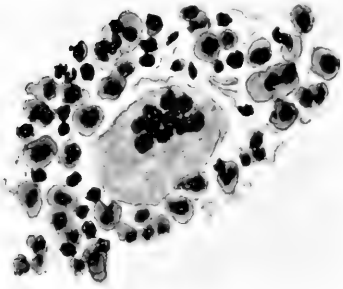


FIG. B.—Case No. 9, Osteoclast surrounded by cells of bone marrow.

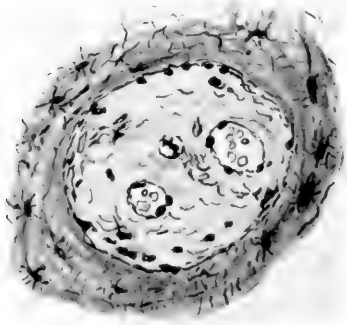


FIG. C.—Case No. 10, Osteoid tissue surrounding Haversian canal.

PLATE VI.

FIGURE A.—Case No. 8. From the head of the femur, showing cartilaginous nodule, but without the formation of new bone. B. and L., oc. 1, obj. $\frac{1}{4}$.

FIGURE B.—Case No. 8. Absorption of compact lamellae and substitution by mucoid tissue. B. and L., oc. 1, obj. $\frac{1}{4}$.

PLATE VII.

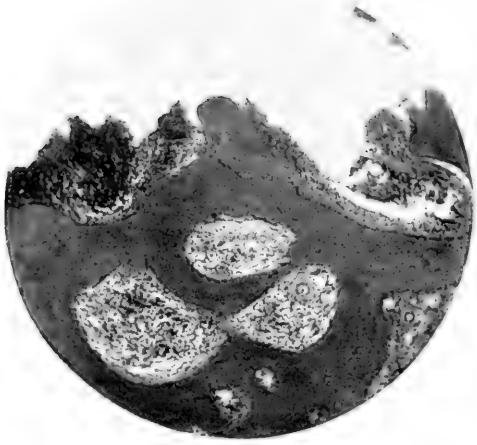


FIGURE A.—Case No. 8. Absorption of compact bone about Haversian canals and replacement by highly cellular tissue. B. and L., oc. 1, obj. $\frac{1}{4}$.

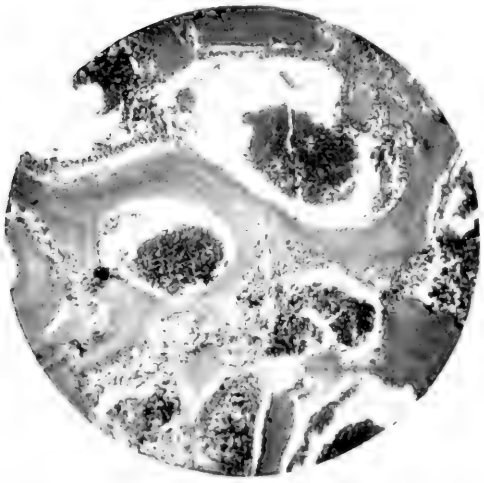


FIGURE B.—Case No. 8. Replacement of marrow by masses of polymorphous cells. B. and L., oc. 1, obj. $\frac{1}{4}$.

PLATE VIII.

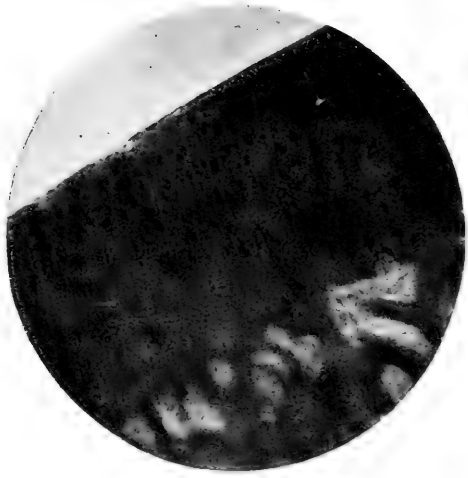


FIGURE A.—Case No. 8. Showing osteoid tissue in cartilage covering the head of femur. B. and L., oc. 1, obj. $\frac{1}{6}$.

FIGURE B.—Case No. 8. Showing osteoid tissue in compact bone, about the Haversian canals. Replacement of bone marrow by highly cellular tissue containing osteoclasts, resembling giant celled sarcoma. B. and L., oc. 1, obj. $\frac{1}{6}$

PLATE IX.

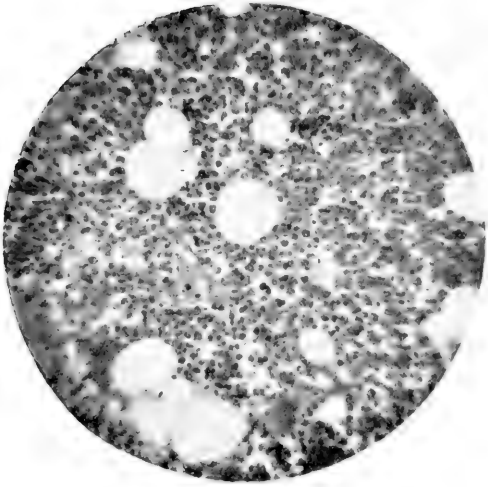


FIGURE A.—Case No. 11. Section of bone marrow, showing almost complete displacement of fat cells by cellular tissue. B. and L., oc. 1, obj. $\frac{2}{3}$.

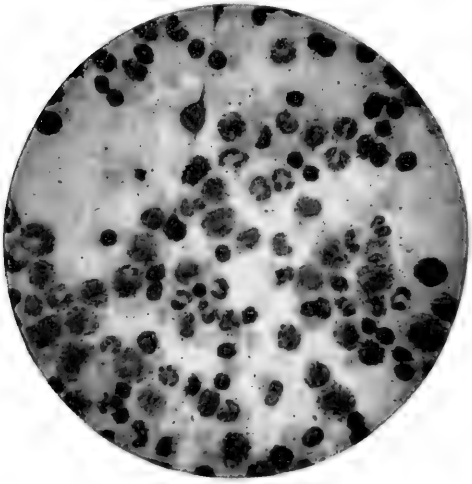


FIGURE B.—Case No. 11. Smear of bone marrow, showing elementary constituents of tissue shown in Figure A. B. and L., oc. 1, obj. $\frac{1}{6}$.

PLATE X.

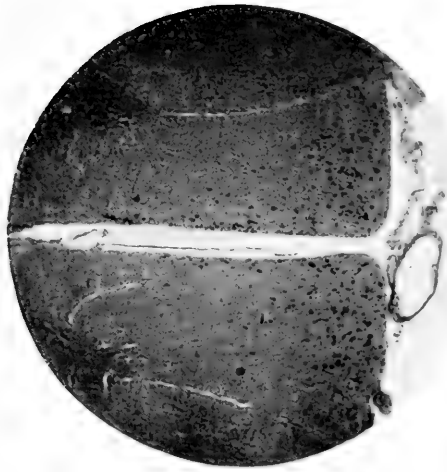


FIGURE A.—Case No. 9. Degeneration of nerve fibers in anterior columns of spinal cord. (Marchii method.) B. and L., oc. 1, obj. $\frac{2}{3}$.

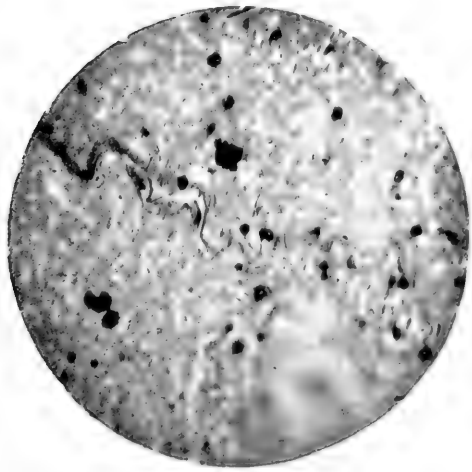


FIGURE B.—Case No. 9. Same. B. and L., oc. 1, obj. $\frac{1}{6}$

THE INDIAN OR SPECTACLED COBRA.

OBSERVATIONS ON THE MENTAL CAPACITY AND HABITS OF POISONOUS SERPENTS.

By RAYMOND L. DITMARS,

CURATOR OF REPTILES.

THE Reptile House of the New York Zoological Park serves two important purposes. The first, and best known, is the maintenance of a thoroughly representative collection of reptiles and batrachians for public exhibition, descriptively labeled, and provided with maps and charts illustrating classification and distribution. Its second purpose is to afford opportunities to observe, from a sympathetic standpoint, the habits of groups, genera and species of particular interest, and to record in print such observations as tend to increase our knowledge of the reptilian world. That line of work began very shortly after the opening of the Park.*

To accurately describe the habits of reptiles, great care and a thoroughly sympathetic interest are necessary. The actions of a single captive specimen are apt to be very misleading. If accepted as illustrating the habits generally of the various species of a genus, or even the habit of the single species it represents, the resulting description would be possibly interesting as popular read-

* The following articles by the Curator of Reptiles have appeared in publications of the New York Zoological Society: Turtles, Terrapins and Tortoises.—Bulletin No. 4. Noteworthy New Reptiles.—Bulletin No. 7. Poisonous Serpents of the New World.—Bulletin No. 11. Poisonous Serpents of the Old World.—Bulletin No. 12. The Big Serpents.—Bulletin No. 14. The Giant Tortoises.—Sixth Annual Report. Observations on the Development of Reptiles, with Notes on Feeding Reptiles in Captivity.—Seventh Annual Report. Observations on Lacertilians.—Eighth Annual Report.

ing matter, but might fall far short of representing actual conditions. In order to write a life history of value, the student must possess a series of specimens. He must note the actions of individuals, and compare one with another, and at the same time he must appreciate certain conditions appealing to the life of the creature in a wild state. Once again the writer must repeat his assertion that the observer must be *sympathetically* interested, for otherwise his notes trend toward a mere recital of actions that possess no especial significance or value.

The Cobras.—The reptile department takes especial pride in what is probably the most thoroughly representative collection of living Cobras ever exhibited in the New World. The majority of these specimens have been in the Park for several years, during which time continuous observations have been made. Thus, in conformity with the object already explained, the Cobras, which have been provided with descriptive labels, and constitute a feature of great interest to visitors, are now in line for a resumé upon their characteristics as observed in captivity. Combined with this collection of notes, we offer an account of the Coral Snakes. The appropriateness of this description will be appreciated by the explanation that the Coral Snakes (Genus *Elaps*) are the only serpents inhabiting the New World which represent the Subfamily to which the Cobras belong. As some species of the former occur in the United States, notes on their habits are interesting as illustrating the diversity of life evinced by creatures structurally related.

It is a popular, though incorrect, idea that a venomous snake may be distinguished by its thick body and wide, triangular head, the latter very distinct from the neck. Such is not the case with the Cobras and their numerous and formidable allies. They are included in the large Family *Colubridae,* embracing the majority of the harmless snakes. From the harmless snakes the Cobras differ not in form, but simply in the possession of short, permanently erect fangs on the forward part of the upper jaw. In general outline they appear to be typical harmless snakes, most of the species closely resembling in a general way the Indigo or Gopher Snake (*Spilotes corais couperi*), a common serpent of our southern states.

To illustrate the relationship of the Cobras and their allies to the harmless snakes, it is necessary to present a tabulated classification of the Family *Colubridae* and its divisions. This Family is divided according to the structure and arrangement of the teeth of its members.

FAMILY COLUBRIDAE.*

DIVISION I. AGLYPHA.
Both jaws with *solid* teeth.
Subfamilies: *Acrochordinae* . . . The non-venomous River Snakes.
Colubrinae . . . . . The typical harmless snakes.
Rhachiodontinae . A single genus and species.

DIVISION II. OPISTHOGLYPHA.
A pair, or several pairs, of *grooved* fangs in the rear of the upper jaw.†
Subfamilies: *Homalopsinae* . . . . The poisonous River Snakes.
Dipsadomorphinae A large Subfamily represented in both the New and the Old Worlds and comprising 69 genera.
Elachistodontinae . A single genus and species.

DIVISION III. PROTEROGLYPHA.
A pair of short, *hollow* fangs, in the front of the upper jaw.
Subfamilies: *Hydrophiinae*. The Sea Snakes.
Elapinae . . . . The Cobras and their allies; the Coral Snakes. This Subfamily comprises 29 genera.

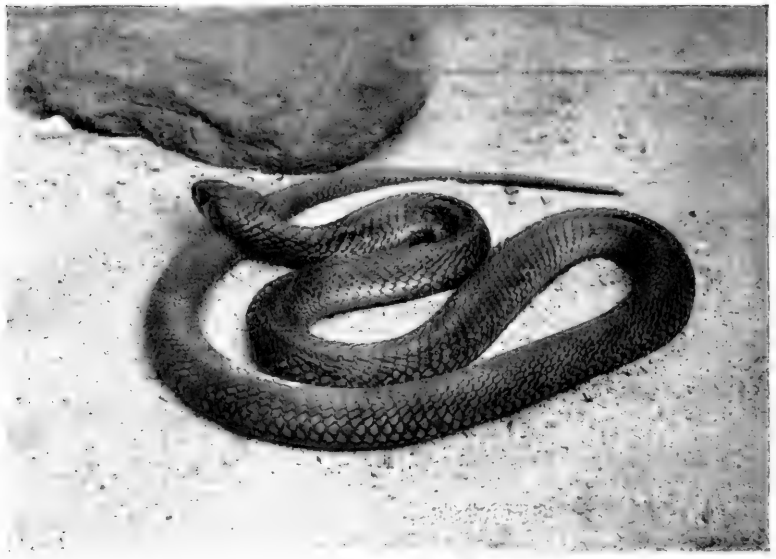
Ten species of Cobras are recognized, and they are widely distributed, as shown in the following list:

Egyptian	Cobra; Asp;	*Naja*	*haje.*		
Yellow	"	"	*flava.*		
Black-Lipped	"	"	*melanoleuca.*		
Black-Necked	"	"	*nigricollis.*	Africa.	
Yellow-Headed	"	"	*anchietae.*		
Gold's	"	"	*goldii.*		
Guenther's	"	"	*guentheri.*		
King	" Hamadryas;	"	*bungarus.*	India, southern China and the Malay Archipelago.	
Spectacled	"	"	*tripudians.*		
Philippine	"	"	*samarensis.*	Philippine Islands	

Numerous closely allied serpents inhabit Africa, India, the Malay Archipelago and Australia, some of which exhibit a tendency to expand the neck and raise the body from the ground when angry, but with none, with the exception of the African genus *Sepedon*, is the character so markedly developed as among the species of *Naja*. It must be understood, however, that not all the species of *Naja* dilate the neck so widely as does the *N. tripudians*. In some the character is but slightly developed.

* Boulenger's classification is followed.

† The Opisthoglyph snakes might be designated as mildly venomous serpents. Their bites are seldom attended by symptoms dangerous to man.



EGYPTIAN COBRA OR "ASP."

In its passive moods, there are no indications of a "hood."

OBSERVATIONS ON CAPTIVE COBRAS.

Compared with the vast majority of other serpents, the snakes of the genus *Naja* exhibit a remarkable degree of intelligence. Their actions appear to be well premeditated. When alarmed they do not dash blindly away, as do most snakes, with an indefinite idea of simply placing distance between reptile and pursuer, but usually dart for some place suggesting shelter, a small opening or crevice. Such actions also demonstrate a more highly developed sense of vision than most serpents seem to possess.

To assert that the species of a genus possess a considerably higher degree of intelligence and a more acutely developed sense of sight than appears in others is to make an important distinction, but to demonstrate that mere theory based upon desultory actions observed in individual specimens has no part in these conclusions, the writer cites various psychological experiments made with Cobras now in the Reptile House.

Experiment No. 1; Egyptian Cobra (N. haje).—A small wooden box, with thin, sliding top, was placed in the cage with the serpent. The lid of the box was left partially open, and into the box for the greater part of the day the reptile retired to hide.

The box was left in the cage for a week, until the snake became thoroughly familiar with it. An opportunity was then awaited of finding the snake prowling about the cage, when the box was taken out, and placed in the center of a room about twelve feet square. The Cobra was then taken from its cage, dropped into a bag, and carried to the room, where it was placed on the floor about six feet from the box. For a moment it dilated its hood, and assumed a fighting posture, but as usual with cobras transported to strange surroundings, dropped to the floor and began gliding about to discover an avenue of escape. The box was moved slightly, to attract the snake's attention to it, and the result awaited. It will be remembered that the box opened at the top, with a sliding lid; and as the snake observed it on the floor, it presented no means of entrance or shelter.

Upon the slight movement of the box, the reptile changed its course and made directly for it. A bright-colored cloth was waved in its path, at which it rose and struck viciously. Promptly continuing its course toward the box, it reached it, raised its head and neck over the top, and in the manner characteristic of the eccentric Asp, literally flung itself into the receptacle.

This test was convincing, but to prove whether it might not have been an accidental wandering of the snake, it was repeated. For fully a dozen successive times, the same occurrence was observed. It demonstrated that the reptile recognized and appreciated its hiding place, although the box possessed no openings on the sides, and could be entered only through the top.

This same experiment was tried with a Chicken Snake (*Coluber quadrivittatus*); an Indigo Snake (*Spilotes corais couperi*); a King Snake (*Ophibolus getulus*), and a Water Snake (*Tropidonotus fasciatus*). All these serpents persistently sought shelter in the box, so long as it remained within their cage; but when annoyed, as was the Cobra, they dashed stupidly about the room, rooting into dark corners and endeavoring to escape, but never succeeding in finding the real hiding-place, even though they frequently passed in close proximity to it.

Experiment No. 2; Cobra-de-Capello (*N. tripudians*).—This test emanated from the actions of a large Cobra that was regularly taken from its cage for the treatment of an abscess.* With a bamboo stick, Keeper Snyder removed the snake from its cage, and placed the reptile upon the floor, where he pinned its head down firmly by holding the stick across it. Afterward the ser-

*The lesion was entirely cured after treatment lasting three months, during which time the reptile was daily taken from the cage.

THE INDIAN OR SPECTACLED COBRA (*NAJA TRIPUDIANS*).

Showing the striking markings on the back of the hood

pent was quickly grasped by the neck, immediately behind the head; and thus firmly held, it was treated by the writer.

It was Mr. Snyder's habit to manipulate the stick with his left hand and grasp the Cobra with the right. After the snake had been taken from the cage about a dozen times, during each of which it vigorously resented the process of handling, it appeared to evince a certain familiarity with the proceedings, and a determination to baffle our operations. As Keeper Snyder approached it with the stick in his left hand, it would quickly turn in its course and glide to the right, thus making it necessary for him to reverse the position in which he stood. These actions were at first considered accidental, but finally they became so markedly persistent that after many tests were made the writer became convinced that the snake appreciated it was in danger of being pinned down by the stick if pursuing a parallel course to the left, on which side the same was held, but that by reversing its direction and darting to the right, it would be leaving behind it the man's defenceless right hand. It was impossible for the snake to glide straight away, for the reason that it was always released in a narrow passage. When caught by the stick and its course changed to the left, it would stubbornly persist—a dozen times or more—in darting to the right.

These actions indicated very clear reasoning powers. Similar manoeuvres have been observed in none of the many other venomous snakes under the writer's care, and were restricted to reptiles of the genus *Naja*.

Experiment No. 3; Sumatran Cobra (*N. tripudians semifasciata*).—A specimen of this snake that for a long time refused food, and was repeatedly taken from its cage to be fed with eggs forced down its throat with a syringe, developed traits exactly similar to those observed in experiment No. 2.

Experiment No. 4; King Cobra (*N. bungarus*).—It has been stated that this species, although strictly cannibalistic, feeds but seldom upon the viperine snakes,* possibly possessing an instinctive dread of the deep wounds liable to be inflicted by the fangs of such reptiles when attacked. To test the veracity of this assertion, the following test was made:

A large, thick-bodied, harmless Water Snake (*Tropidonotus taxispilotus*), and a poisonous Water Moccasin (*Ancistrodon piscivorus*), of much the same proportions, were selected for the experiment during a period when the big Cobra was voraciously awaiting its weekly meal of a living snake. The door of the cage

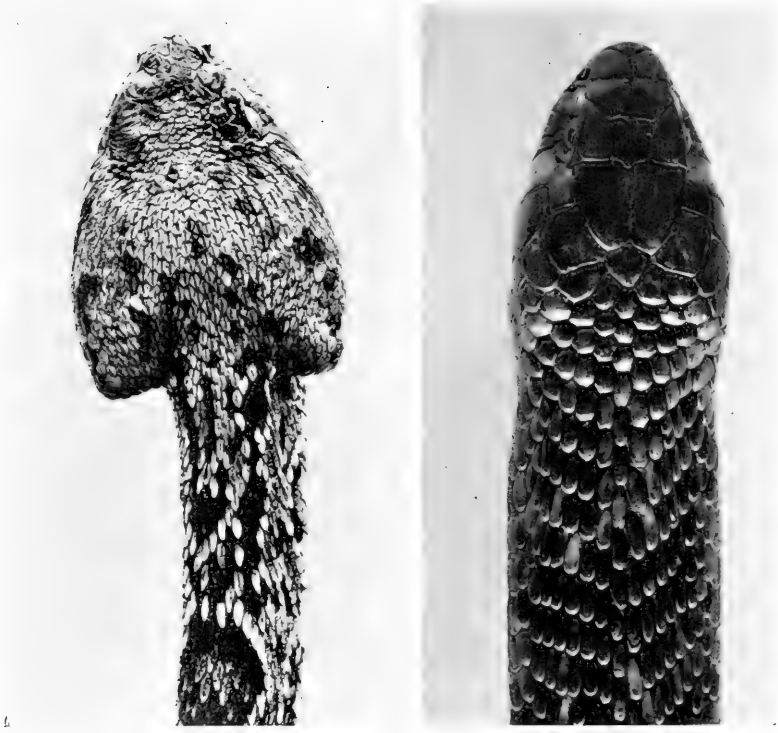
* These serpents possess very long, erectile fangs.

DILATED HOOD OF INDIAN COBRA.

was rolled back, and the poisonous snake thrown inside. The Cobra made the customary rush for the food, but upon reaching the snake paused abruptly.

This was the first time in the feeding of this King Cobra in our Reptile House that he failed to immediately seize his victim and begin to swallow it. The Moccasin was permitted to remain in the cage for about five minutes, during which time the Cobra reared slightly from the floor, and regarded it intently. To ascertain whether the Cobra was hungry, a common striped snake was placed in the cage. It was grasped and swallowed without hesitation.

The Moccasin was again introduced. There was the same rush, and the same careful examination of the newcomer. This time, annoyed by the unceremonious treatment it had received, the "pit-viper" showed fight. Upon this display of hostility the Cobra backed off hurriedly, nervously dilating its "hood," and rearing

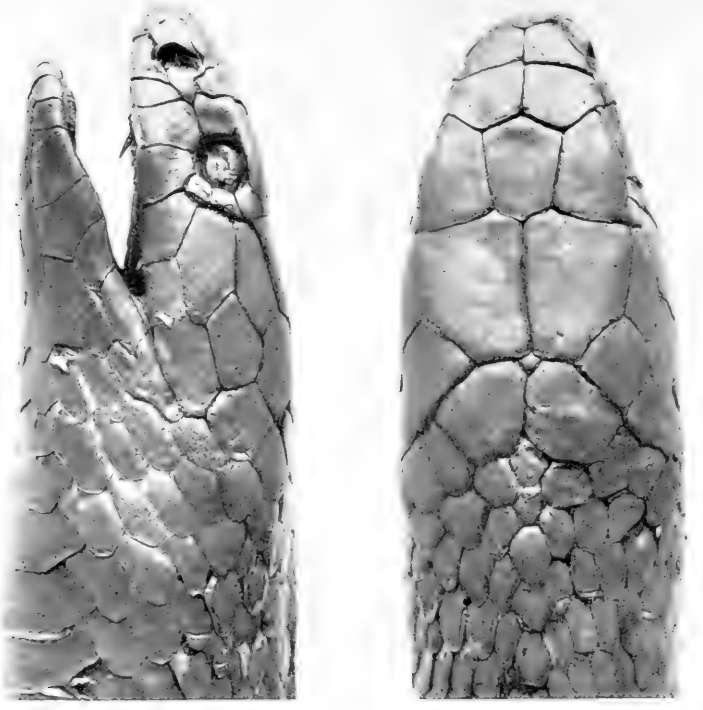


HEADS OF RATTLESNAKE AND EGYPTIAN COBRA.

The great difference of outline between the heads of the Viperine and Colubrine snakes is strikingly marked.

upward. The Moccasin was finally removed unharmed, and the large, harmless Water Snake was quietly placed in the cage. To the human observer it matched the Moccasin closely, and made a show of temper considerably more emphatic than the former, but the Cobra attacked it without an instant's hesitation and soon swallowed it. This experiment was repeated, and always with the same result. The Cobra appeared to instantly distinguish the dangerous character of the poisonous snake.

Of all species of snakes under the writer's observation, the King Cobra is the most intelligent. Its actions indicate quick reasoning. A slight movement at the door of its cage will bring it rushing to the opening, where it prowls about, nosing and inserting its tongue along the frame, in the anticipation of food. This snake has been frequently observed, as the feeding period



HEAD OF THE KING COBRA.

The fangs are proportionately much smaller than those of the Viperine serpent (rattlesnake) shown by another illustration.

was approaching, to assume the graceful attitude of its kind—head and neck upraised to the level of the small plate-glass window in the door of its cage—and follow intently, with turning head, the movements of the keepers in the passage behind the cages.

In serpents, such actions are unusual. They appeal more to the mental faculties exhibited by mammals. In numerous other instances the writer and his keepers have noted the unusual intelligence of the Cobras. Their apparent sagacity, together with the possession of fangs, and probably the most virulent poison of all snakes, demands the greatest caution on the part of those who maintain a collection of living specimens.

Disposition of Cobras.—Compared with other serpents, both

HEAD OF RATTLESNAKE

The fangs are very large in comparison to the poison-conducting teeth of the King Cobra.

venomous and harmless, the Cobras appear to be the most vicious and untamable. Even after years of captivity the majority of specimens remain as frenziedly hostile as when first received from their native wilds. The stories of wild Cobras wantonly attacking men have been much condemned as fallacious and sensational. They can not be, however, entirely devoid of foundation and truthfulness. On many occasions the writer has noted signs of aggressiveness on the part of angry Cobras that clearly indicate a more dangerous class of serpents than thick-bodied and sluggish viperine snakes.

Two specimens of the Masked Cobra (*N. tripudians semifasciata*) have been in the Reptile House for over three years. They are fully as vicious to-day as upon their arrival at the Park. When angered, these snakes will rear their bodies more than a third of their length from the ground, and with dilated necks, spreading to the width of a man's palm, remain in this position indefinitely—until all causes of annoyance have passed. The opening of their door and a slight wave of the hand is sufficient to throw these snakes into a frenzy of anger. While rearing to strike, they are exceedingly nervous. A slight turn of the hand, or the movement of a stick will cause them to start like a nervous horse at a gun-shot. They strike forward and down

ward, and with such force that they generally slide forward bodily, with the movement of the darting anterior portion. A few successive strikes thus bring them nearer the object of their anger, when they rear still higher, striking with a sharp hiss, which can be heard seventy-five feet or more. When near the object of their anger, they evince a bold habit of suddenly dropping from the upright position, darting forward, then flinging the body into the upright position again. This trait brings the serpent uncomfortably near the observer.

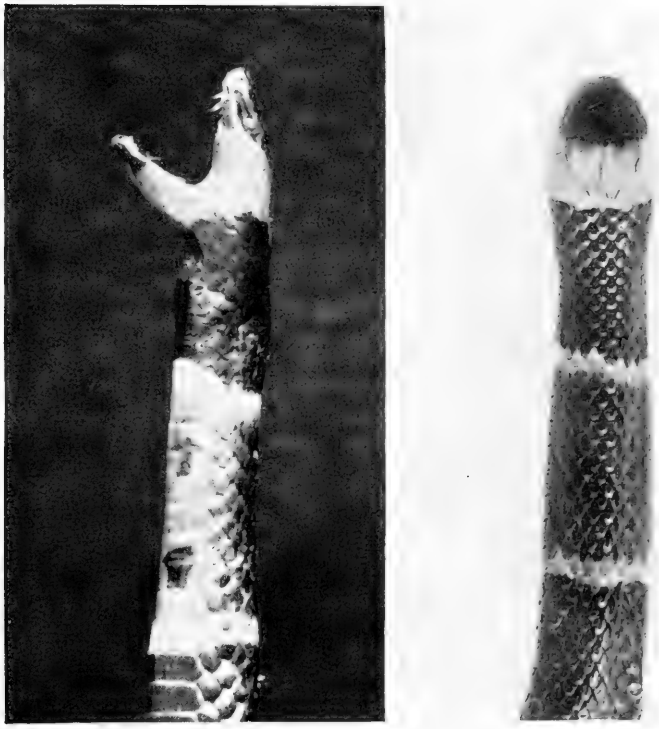
It is an action devoid of fear, and is common to all the Cobras when in a state of perfect health and vigor. It is most frequently enacted by the King Cobra, a bold and seemingly fearless reptile, that will obey no threat, and is, on the whole, the most dangerous in disposition and fang-power of all poisonous snakes. It is concerning this snake that most of the stories relating to actual aggressiveness toward man have emanated.

It is rather fortunate for interested visitors in the Reptile House that these snakes retain their wild nature, as the spreading of the hood of the spectacled Cobras, with the attendant display of the weird and vivid markings upon the same, constitute a sight that is long remembered, and often recalls tales of India. The deadly pit-vipers—the Fer-de-Lance, the Bushmaster, and their thick-bodied Old-World allies * of the warm sands of desert Africa—although much reputed for ferocity, after they have been a few months in captivity, become tame and show few signs of bad temper, even when closely inspected.

In biting, the Cobras exhibit a different series of movements from those displayed by the viperine snakes, with their long, erectile fangs. When striking, the latter throw open the jaws to a great angle, and the fangs literally stab the object aimed at. At the instant of penetration there is a biting movement, to make the poison-conducting teeth penetrate as deeply as possible. The two processes are almost simultaneous, and to the eye the effect is simply a lightning-like dart and return to the original position of defence, with no pause between the two motions. Sometimes, however, the Rattlesnake holds fast to its victim for a space of one or two seconds.

With the Cobras, such movements would be productive of but little effect, owing to the shortness of the fangs. If the Cobra reaches the offending object, it grasps it tenaciously, and with the peculiar chewing motion of the jaws characteristic of snakes, advances the fangs several times, stabbing deeply with them, and

*The latter of the Subfamily *Viperinae*.



HEAD OF CORAL SNAKE.

The fang formation of this North American serpent demonstrates its relationship to the Cobras.

thus producing several wounds from each. The duration of the biting movements may be from one to several seconds, depending upon the state of the reptile's irritability. A man wearing ordinary summer underclothing and a thin suit without, might consider his limbs protected from a Cobra's fangs, as the latter would be too short to penetrate the several thicknesses of thin cloth, unless the garments fitted very tightly, and the snake secured a most favorable hold.

It has been observed that a Cobra is unable to kill an angora guinea pig except when the serpent grasps the animal by a limb or by the nose. When seized by the body, the poison is expended in the fur of the animal, the fangs being too short to reach the flesh. Bitten animals die quickly from what appears to be a rapid paralysis, during which there are but slight struggles, and they appear to suffer but little pain.

The writer has never noted the reputed ability of the Cobras to forcibly eject their venom when in a coiled and defensive position. He realizes, however, that the savage hisses they give when striking might possibly expel a drop of their formidable secretion to some distance, if it were issuing from the fangs; and he believes that there may be instances when in striking and hissing simultaneously the snake compresses the poison glands by the contraction of the jaw muscles, and ejects the poison, though quite accidentally, in the direction of the object of its anger. If this fluid should enter the eyes, blindness or death are very probable consequences.

Feeding habits.—All of the snakes of the genus *Naja* are very hardy in captivity, and feed readily, if given proper care, which appeals particularly to the shedding of the skin, an inability to perform which process and consequent disregard on the part of the keeper, will result in the death of the majority of specimens. Most of the species feed upon small rodents, birds and eggs. The latter are swallowed entire. Some species, of which the Indian, or Spectacled Cobra, is one, evince a fondness for frogs. In fact, as compared to the feeding habits of various serpents of their size, several of the species may be said to be omnivorous.

The food is not suddenly "struck," as is the custom with the long-fanged snakes (*Viperidae*), but is actively pursued and grasped firmly, the jaws of the reptile being worked in such a manner that several wounds are produced by the fangs. After thus quickly injecting the animal with its venom, and inflicting such a shock that it is powerless to offer voluntary opposition, the snake begins at once to swallow its prey, paying little attention to the struggles which some creatures continue during the entire process of deglutition.

During the periods of feeding, these serpents sometimes fight viciously with each other, producing wounds which to other animals soon would prove fatal, but resulting in no ill effects upon the snakes themselves, they being entirely immune to the effects of their own poison.

The King Cobra (*N. bungarus*) is a cannibalistic species, in captivity usually refusing everything but snakes. While feeding it not only displays considerable cunning, but also great agility. When a snake is placed in the cage, the Cobra dashes upon it, seizes it by the middle of the body, and within a few seconds' time the fangs have done their work. Snakes, however, are rather slow to succumb to the venom of these reptiles. On the part of the victim there is vigorous opposition to being thus treated. The

Cobra is repeatedly bitten, but it regards with stoical indifference the superficial wounds inflicted by the teeth of its prey, and continues working the body of the snake along in its jaws with the idea of reaching the head, which portion is first swallowed. Sometimes the quarry is seized near the head, and in such cases it is soon disappearing down the Cobra's throat. Frequently, however, the Cobra has some trouble in working its jaws toward the victim's head. At such times the larger reptile pauses often, and awaits an opportunity of seizing the other by the neck. If the attacked snake makes a movement to bite the Cobra on head or neck, there is a counter movement of great rapidity. The body is released and the approaching head is seized with astonishing quickness, after which performance the engulfing process begins without more ado.

The fine representative of this species in the Reptile House has no aversion to taking snakes that have been freshly killed. Its good-nature permits economy to be practiced, for in times of scarcity each snake offered is first killed and stuffed to its full capacity with frogs or rats, and thus it is made to equal in bulk and nourishment a half-dozen snakes of equal length not treated in this manner. It is alleged that the King Cobra feeds upon lizards, an assertion rendered rather doubtful by the action of this specimen. Its cage is shared by half a dozen species of small lizards, which for several years have interested visitors by their lively antics, running fearlessly up and down the walls, and even along the snake's body, without molestation or any hostile notice on the ophidian's part.

After feeding, all Cobras delight to bathe. Their positions in the water often alarm uninitiated visitors, for they frequently float on their sides or their backs in a manner that suggests an animal for some time drowned and inflated with the gases of decomposition.

Relationship.—In habits and structural relationships, several genera of snakes closely approach the serpents of the Genus *Naja*. These are the species of the African genus *Sepedon*, the Indian and Malayan genus *Bungarus*, and the Australian genera *Pseudechis* and *Hoplocephalus*. All of these snakes display a vivacity and intelligence strongly appealing to the Cobras. *Hoplocephalus* and *Sepedon* are very strongly suggestive of the actions of the various species of *Naja*.

NEW WORLD ALLIES OF THE COBRAS.

The single Genus *Elaps* represents the Subfamily *Elapinae* in the New World. About 26 species are recognized. Two occur in the southern United States. The others are distributed throughout Mexico, Central America and tropical South America.

After dealing with the habits of such interesting and formidable serpents as the Cobras, it is appropriate to record the observations made in the Reptile House on these New World allies. The Coral Snakes are not so highly organized as the Cobras—in fact, they are rather addicted to a burrowing existence. They are cylindrical in form, with small, blunt heads. They are vividly marked with red, black and yellow, disposed in rings, and are thus easily recognized, although various harmless snakes evince striking similarities of pattern.

Despite certain emphatic assertions to the contrary, the Coral Snakes are highly venomous. In proportion to the size of the reptiles, their fangs and poison are capable of inflicting damage almost on a par with their Old World allies. Few of the Coral Snakes attain a maximum length of more than three and one-half feet.

Three species of these serpents have been on exhibition in the Reptile House, namely: the Harlequin Snake (*Elaps fulvius*), of the southeastern United States and Mexico, the Sonoran Coral Snake (*E. euryxanthus*), and the South American Coral Snake (*E. corallinus*). Of the first-named species, several hundred specimens have, from time to time, been under the writer's observation; and of the second rare species but one specimen was procured. The last species noted ranges over an extensive area in tropical South America, and is found in several islands of the Lesser Antilles. Numerous specimens of this snake have been received from the island of Trinidad.

As the habits of the different species of *Elaps* observed were found to be very similar, the writer will place them under one general heading.

Habits.—The snakes of the Genus *Elaps* rank rather low in mental powers. Their movements are erratic. They appear mentally stupified by captivity. Their prevailing idea is to hide, to avoid the light and observation, and this they do if there be any facilities for burrowing or coiling beneath some object. Once secreted, all ideas of food and sensations of appetite appear to vanish from the majority of captive specimens. The proper

food may be regularly introduced, or left with them, yet in the midst of plenty, after fasts lasting from six to ten months, they slowly but deliberately starve. Although utterly disregarding the presence of food, they evince an interesting desire for water, for which they regularly search their cage, and when it is found, they drink long and copiously.

When placed upon the ground, they do not exhibit the aggressiveness of the Cobra, nor do they engage in a constant search for a crevice or burrow in which shelter may be sought. Instead, the Coral Snake trails blindly forward, head flat to the ground, seeking to escape from a danger which to its dull senses is being distanced by simply moving, no matter in what direction. Crevices and other hiding places may be passed unnoticed when but a few inches distant. There is no disposition to intimidate the enemy by a show of fight; the dominant idea is to steadily progress until the hoped-for security is attained. Upon reaching grass, or the like, the snake's appreciation of its power to employ such ground to advantage is immediately noted. With the rapidity of a knitting-needle being deftly inserted in various strands, the snake literally weaves its way among the blades, *at their base*, and even though the grass be comparatively short, the reptile is soon entirely hidden. It moves forward with a nicety that only slightly stirs the growth, and the snake's whereabouts is difficult to ascertain. And now, if disturbed in its progress, it quickly draws its body into close lateral undulations, and remains motionless, evincing that in this situation the reptile is sufficiently in its element to deliberate upon its actions with some display of mental power. If, after gliding wildly and aimlessly over a smooth area, a Coral Snake comes upon soft, uneven ground, like the surface of a ploughed field, its demeanor changes, it intently follows every depression to which it comes, roots with its nose for soft spots in which to burrow, and usually manages to quickly secrete itself.

Such actions indicate an underground existence, as is indeed the fact, and when the writer refers to the Coral Snake as a reptile of dull mentality as compared with the Cobra, the assertion should not be misconstrued as an assertion of entire helplessness in defense on the part of the former. We have two animals of different environment, one—the Cobra—mentally ready for the dangers that must be met by a reptile preying above ground, and consequently employing the proper measures to intimidate an enemy, but also with sufficient resourcefulness in seeking adequate shelter. On the other hand, the Coral Snake is a creature

of burrowing habits, with rather poorly developed eyes, is quite out of its element when placed upon hard and flat ground, but when on ground that favors its burrrowing existence it displays proper resourcefulness.

In comparing these two genera of serpents, however, the student will appreciate that these New World representatives of the large Subfamily *Elapinae* are but degenerate allies of the Cobras. Between the latter and the Genus *Elaps,* in the annals of technical classification, come many connecting genera; but all are of the Old World.

Many observers allege that the Coral Snakes are quite mild in disposition, and seldom or never attempt to bite. Such intimations are not only fallacious, but dangerously misleading, and tend to invite accidents from reptiles that are highly formidable. Observed closely, these snakes will be found to evince methods of defense that are unique in comparison with the other poisonous snakes of the Western Hemisphere. They seldom strike forward at an offending object, but twist and snap from side to side with the rapidity of motion of a well-tempered steel spring upon being released from a strained position. So energetic are these actions at times, that specimens touched lightly with a stick, will, with lightning-like agility, swing about and grasp their own bodies. These snakes bite as do the Cobras. They grasp the object of their anger, and by a chewing motion advance the fangs so as to sink them in a line of perforations usually producing about four separate wounds with each fang.

The truth is that occasional specimens, especially of our southern species, *Elaps fulvius,* appear to be very docile if handled. The writer has experimented with such specimens, protecting his hands with heavy buckskin gloves, through which the fangs could not penetrate. The results were interesting, and demonstrate with what degree of safety a reckless person might handle these poisonous, but apparently gentle, and pretty creatures.

Specimen a, arrived from Lake Kerr, Florida, and with a gloved hand was lifted from its box. It did not at all appear to resent the familiarity, and for five minutes or more was permitted to glide from one hand to the other. Presently a restraining motion, resulting in a slight pressure of the fingers, caused it to turn and grasp an index finger, advancing the fangs in rapid succession, and staining the glove with a flow of poison.

Specimen b, from Hampton County, South Carolina, was yet more docile. It was carried about for twenty minutes or more, and unceremoniously handled with no trace of anger. Upon

attempting to grasp it a few inches behind the head, however, it turned and bit viciously.

The preceding illustrations indicate the average actions of a large number of Florida specimens that have been examined in the manner named. Some specimens, however, when grasped, have instantly turned and bitten the operator. This tendency has been particularly noticeable in the larger species, *Elaps corallinus* and *E. marcgravii* of tropical South America. A specimen of the former, 14 inches in length, was very vicious, and would turn and bite upon the least provocation, although it never *struck forward* save when grasping its prey.

Regarding their danger to human life, the Coral Snakes must be placed in rather a different class from the long-fanged serpents that strike. A child running about bare-footed would be in danger of receiving a bite from a snake trodden upon; and woodmen also are in danger, for these snakes often hide under fallen logs. However, the danger from these gaudily colored and easily recognized reptiles, with minute fangs, is but slight as compared with the long, sharp fangs of a rattlesnake, which could easily pierce clothing of ordinary thickness.

Feeding Habits.—Like many of the Elapine Snakes, and especially those that are addicted to burrowing habits, the Coral Snakes are cannibalistic, feeding almost entirely upon other snakes, and upon lizards. The method of feeding is similar to that of the King Cobra, though these smaller snakes display less ingenuity in overpowering their prey. It is quickly grasped and worked along in the jaws until the head points down the throat, when swallowing commences. Upon cold-blooded prey the poison is slow in taking effect; and, although the fangs may be observed to be repeatedly and vigorously employed, the subtle fluid appears to aid the snake but little in subduing the quarry, which generally struggles energetically during the entire swallowing process.

These snakes will consume serpents of surprising dimensions in proportion to their own length and thickness of body. On several occasions the writer has observed the Harlequin Snake (*E. fulvius*) swallowing snakes that were but a few inches shorter than the feeding reptile, and of greater circumference of body! After completing a meal of such proportions, the gorged snake is rendered so rigid of body that it is unable to coil properly, and the skin is so greatly distended that the scales appear as well-separated rows of dots on the body.

All of the species evince a liking for lizards, and especially the

smooth-scaled species of the Family *Scincidae*. Numerous captive specimens of the Harlequin Snake have fed upon the blue-tailed lizard (*Eumeces quinquelineatus*), while specimens of the large South American Coral Snake (*E. corallinus*) have taken adult specimens of the red-headed lizard (*Eumeces quinquelineatus erythrocephalus*) fully nine inches in length, and of stout proportions. The lizards show much more susceptibilty to the action of the poison than snakes.

Similarity to Harmless Snakes.—In all districts where species of the genus *Elaps* are found, various species of harmless snakes occur, evincing a remarkable similarity in colors and in pattern. On these we find the brilliant scarlet, yellow and the black rings, together with the certain elegance of form that distinguishes the Coral Snakes to a degree that would at once confuse any but the technically informed.

Careful examination will demonstrate a valuable character that may be generally employed in distinguishing the venomous from the harmless reptiles. It will be noted that in the case of the poisonous snake, the *black rings are single, and bordered by a pair of yellow rings.* With the harmless species *the yellow rings are single, and bordered by a pair of black rings.* The most remarkable instance of resemblance noted by the writer between a species of *Elaps* and a non-venomous serpent occurred in a series of snakes received from southern Mexico. The *Elaps* in question was a variety of *E. fulvius,* a form with narrow black rings, separated by very wide interspaces of red, the black narrowly and obscurely bordered with yellow. The harmless snake was the *Ophibolus micropholis,* a reptile closely related to the Red King Snake, *Ophibolus doliatus,* of our southern states. The serpent in question possessed the narrow black rings separated by wide spaces of red, but close examination disclosed a faint and very narrow yellow ring within the black. Hurriedly examined, these snakes might have been pronounced identical. To add to the deception, the head of each was black, with a yellow band crossing the temples. Such conditions point to some definite provision of Nature. It would be a bold assertion, and but a mere theory, to declare that the harmless snake has acquired the coloration of the poisonous reptile in order that it might inspire respect from its enemies. It appears certain, however, that this similarity of pattern and color and form, between creatures that are separated in classification by marked internal differences in structure, should indicate no uncertain process of evolution, but one which is governed by conditions as yet unknown to man.

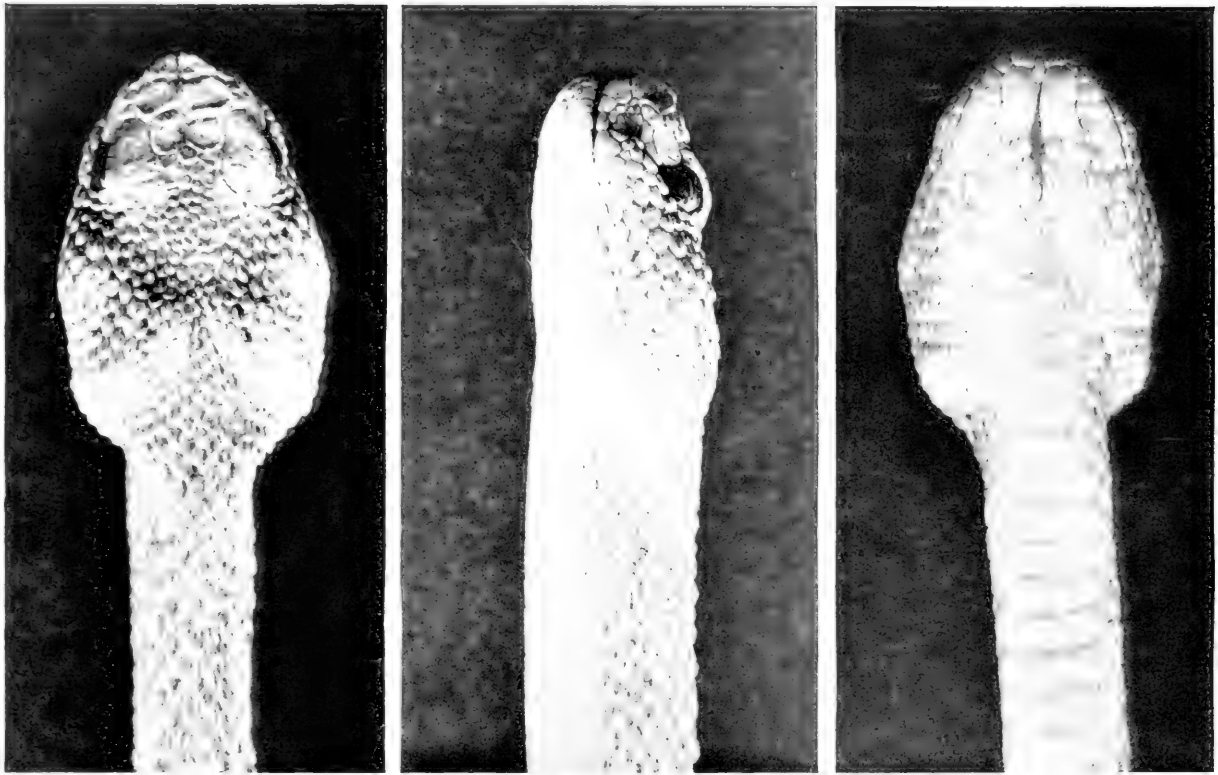
THE GRAY RATTLESNAKE.
A photograph from life, in the Zoological Park.

A NEW SPECIES OF RATTLESNAKE.

By RAYMOND L. DITMARS,
CURATOR OF REPTILES.

WHEN it is considered that vast tracts of Central America and South America have been but little explored by the collector of reptiles, it is not surprising that new and strikingly-colored species are found in such districts. Some years have elapsed since a species has been added to the important genus *Crotalus*—comprising the larger rattlesnakes. The writer takes pleasure in describing a specimen now living in our Reptile House, which, after thorough consideration, appears to represent a hitherto unknown species, quite unique among allied snakes of the genus. This snake probably represents a small species which is confined to sandy areas of Central America.

The specimen under consideration was presented to the Society by Mr. Robert Schilling, of No. 28 Cooper Square, New York. It has been on exhibition for about five months, during which



HEAD OF THE GRAY RATTLESNAKE

time its striking blue-gray color has attracted considerable interest. The snake presents the appearance of being coated with pumice dust.

CROTALUS PULVIS. SP. NOV.

GRAY RATTLESNAKE.

Locality.—This specimen was captured twenty miles inland from Managua, Nicaragua, *in a very dry, sandy district.*

Relationship.—The species is most nearly related to *Crotalus durissus* (*terrificus*) of Mexico, Central and South America, from which it differs in the following characters:

1. The much smoother character of the scales of the head;

2. The less tubercular striation of the scales of the dorsal region;

3. The entirely different ground color, and almost total absence of color pattern;

4. Its small size at maturity. The specimen described is adult, yet it measures but a trifle over two feet in length, while *C. durissus* attains a length of six feet.

Scalation.—On the upper surface of the snout are three pairs of plates, the central pair much the larger, and extending to about one-third the length of the supraoculars. There are three rows of flat scales between the central portion of the supraoculars. The central portion of the top of the head is covered with small, almost smooth scales. The scales of the temporal region are strongly keeled, although the carinae are not so sharply raised as with *C. durissus.* There are thirteen superior labials. Four rows of scales separate the eye from the labial plates.

The dorsal scales are in twenty-seven rows. All but the first and second rows are strongly carinated, those of the median region possessing tubercular carinae, though this character is considerably less pronounced than with the related species. A count of the abdominal plates and urosteges shows 167 of the former and 23 of the latter. The anal is entire.

Coloration.—The color is uniform pale, bluish-gray above, matching the tint of pumice-stone. There is practically no color pattern. Immediately after the epidermis has been shed, a chain of very obscure rhombs, of a slightly darker tint than the body color, may be discerned if the skin is distended. There are no traces of head-markings. The upper surface of the tail is of the same general color as the body. The abdomen and first row of scales are pinkish-white, which tint is deeper on the outer edges of the gastrosteges.

On many of the dorsal scales the apices of the striae are black and shining. The effect produced, if examined closely, is that of a black snake, coated with blue-gray dust and lightly rubbed here and there, thus removing the covering from the raised keels of the scales. The skin between the scales is of the same gray tint as the latter. The possibility of albinism in this specimen has been fully considered, and is believed to have no bearing upon the case.

Dimensions.—That this specimen represents a small species is indicated by the uniform character of the joints of the rattle—five in number—as compared to the size of the snake. The measurements of the type specimen are as follows:

Total length, 27¼ inches.
Length of tail (not including rattle), 2⅛ inches.
Diameter thickest part of body, 1⅛ inches.
Width of head, 1 inch.
Length of head, 1⅜ inches.

AN UNUSUAL VARIATION OF CROTALUS LUCIFER.

By RAYMOND L. DITMARS,
CURATOR OF REPTILES.

AMONG a series of living snakes deposited in the Park by the Brooklyn Institute of Arts and Sciences, through Mr. George Englehardt, is a peculiar specimen of *Crotalus lucifer,* from Beaver County, Utah.

The pattern of this snake is so unusual it seems worthy of particular notice, together with an illustration of the specimen, as an example of interesting variation. The author refrains from proposing a varietal name until a series of specimens can be procured which will demonstrate the constancy of a subspecies, provided it actually exists.

Description.—General ground color pale, greenish-gray. In place of the dark, subquadrate blotches, narrowly bordered with black, as they exist on typical specimens, there are solid, sooty-black patches, in some of which the tips of a few scales are tinged with the ground color. Posteriorly, these markings assume a vividly ringed appearance. Each of the lateral blotches are represented by single scales tinged with black. The dark band from the orbit to the angle of mouth is almost obsolete, and lacks the

CROTALUS LUCIFER

pale borders to be observed in typical specimens. Above, the head is curiously and profusely blotched with black, which suffuses and obliterates traces of the usual parallel lines on the supraorbital plates.

The general effect of the pale greenish body with jet black patches is very striking and handsome.

Dimensions.—Total length, 34 inches; diameter thickest part of body, 1¼ inches.

From the character of the rattle, which possesses four segments, all of which are of uniform size, the snake appears to be mature.

Locality.—The specimen was taken on a ledge, at an elevation of 8,000 feet, in the Beaver Range of Mountains in Utah, by George P. Englehardt, while collecting for the Brooklyn Museum of Arts and Sciences. Mr. Englehardt explains that at a lower altitude he found snakes of the typical form. Upon higher ledges, very difficult of access, he observed several specimens which resembled the one described, but they escaped among the rocks.

OSTRICHES ON A CALIFORNIA OSTRICH-FARM

By permission of Mr Edwin Cawston

THE OSTRICHES AND THEIR ALLIES.

By C. WILLIAM BEEBE,

CURATOR OF BIRDS.

PART I.—GENERAL ACCOUNT.

ON December 25, 1904, the Ostrich House in the New York Zoological Park was opened to the public. This building will eventually be filled with birds of this great Subclass, of which there are four groups living on the earth to-day—the Ostriches, Rheas, Emeus, Cassowaries and, like dimunitive Davids among these Goliaths, the Apteryges or Kiwis. These birds well deserve an entire building to themselves, for not only are they of majestic appearance and of great interest to the ordinary visitor, but to the zoologist they offer for future work a host of unsolved problems.*

These great birds possess much the same interest for us as does the remnant of the races of American aborigines. One, as surely as the other, is bound, before many years, to disappear from the surface of the earth and become but a memory. Indeed, as the races which evolved the highest degree of civilization and culture indigenous to our continent have already vanished, so the birds of extremest specialization in this Subclass have also disappeared. The Aztecs have vanished from Mexico, and the gigantic, twelve-foot, ostrich-like Moas have gone forever from the forests of New Zealand.

The traditions of the Indians reach back seven or eight hundred years; while in the bodies and bones of the great running birds are hints which hark back millions of years. Indeed the more we study this isolated group of birds, the more does their origin become a mystery. Isolated they are, both in structure and distribution, to a more remarkable extent than any other group. Like Hatteria among reptiles, Amphioxus among fishes, and the lowly brachiopod mollusks, these birds are remnants of

* Especial care has been given to the preparation of the large general descriptive labels of the species exhibited in the Ostrich House. A label is provided for each group, giving a concise account of the bird's habits and characteristics, a map of distribution and photographs or drawings of its nest and eggs, chicks, wings, etc., to which is added a specimen of the actual feather of the bird.

races which flourished in past ages and now linger only in a few isolated localities.

Of all birds they are the most unbirdlike, combining characteristics which are extremely specialized with others which are startlingly reptilian.

In many ways these birds stand alone, sharply set off from the great Subclass of flying birds; yet, such is the homogeneity of all birds—so similar is the structural mould in which they are all cast, that there is actually less difference between the two extremes—an ostrich and a crow—than between a marine turtle and a land tortoise, or a common lizard and a chameleon, members of comparatively subordinate groups of reptiles.

During the Mesozoic Age, reptiles ruled the earth by means of their great size and fierceness. Following hard upon their decline, the mammals came to the fore. During all these millions of years untold numbers of birds lived and died, taking small part in the great struggle for supremacy, but keeping to the branches and leaves of the conifers and cycads of those ages.

At some time in this mysterious past, how and when we can only guess, several groups of birds found certain places of refuge, widely isolated, where, by flying less and trusting more to speed in running, they were able to avoid their enemies, live and multiply. These were the ancestors of the living Ostriches, Rheas, Emeus, Cassowaries and Apteryges, which form the subject of the present paper.

We may cite Archaeopteryx, the famous bird of the Jurassic period, with its lizard's tail, teeth and claws, and its bird's beak, feathers and feet, as perhaps representing the avian stem before the ancestors of the Ostriches began to diverge from an arboreal and volant condition to one which eventually resulted in making them wholly terrestrial and cursorial.

A thrush will serve as an example of one of the highest groups of those birds which, holding true to the traditions of their ancestors, kept to the tree-tops, becoming expert flyers, and gaining in sweetness of voice and in tint of feather, rather than in mere grossness of size.

THE APTERYX.

In New Zealand we find the Apteryx, the most diminutive and defenceless of the Ostrich tribe, yet living in safety in this isolated land until man came with his guns and dogs. The days of the Apteryx are now numbered. It is about the size of a domestic fowl, and is covered with long, loose, hair-like feathers.

THE APTERYX

From a mounted specimen in the American Museum of Natural History.

The wings are so tiny that they are completely concealed by the body plumage. Its feet and legs are stout, and it has four toes. The bill is long and slender, and, strange to say, the nostrils, instead of being at the base of the bill, as in other birds, are placed near its tip, the nasal cavity running up the full length of the bill, and even filling up the space between the eyes.

As a rule, those creatures which excel in powers of scent have correspondingly deficient eyesight, as is the case in dogs and wolves. In birds, with but one exception, the reverse is true, their eyes being greatly developed, while their nostrils are small. The exception is the Apteryx, which is one of the few birds which finds its prey by scent instead of sight. This bird is nocturnal in its habits, and its principal food consists of earth-worms. Obviously, eyes would be of little assistance in obtaining worms. The sense of smell is of greatest service, aided to a certain extent by touch. The latter sense operates through a number of long, hair like feelers which grow from different portions of the head and sometimes reach a length of six inches—analogous, but not homologous, to the whiskers of a cat.

THE EMEU

The female Apteryx digs a shallow burrow in the earth, lays two very large, white eggs therein, and goes her way. The male then takes entire charge of the incubation, and also rears the chicks.

THE EMEU.

The Emeu is the Australian representative of the struthious birds and is first cousin to the cassowary. This bird shares the great grassy plains with the kangaroos, and before the arrival of man had but few foes; for Australia was cut off from the rest of the world long before the fleet, wolf-like carnivores were evolved. The Emeu stands from five to six feet in height, and

CERAM CASSOWARY.

is covered with brown, harsh, double feathers. Its note is a deep booming sound which can be heard a long distance.

Nature is sometimes economical, even to the minutest details, and an excellent example of this is found in the feathers of these flightless birds, which are devoid of the interlocking hooklets which make possible the flight of other types of feathered creatures.

The eggs of the Emeu are from seven to eighteen in number, and are laid in a roughly trampled nest of grass. As is the rule among the birds of this Subclass, the male takes upon himself the duties of incubation and rears the chicks, while the female takes charge of the brood of the previous year. The chicks are not of a dull-brown colour, like their parents, but are striped with

bands of black. Aflalo states that "in the year 1888, upwards of ten thousand Emeus were destroyed in one district of Australia alone, while in the same period fifteen hundred of their eggs were broken on one estate. Farmers allege that these birds steal their grass and tear their fences.

"In fact, Nature's balance seems to have got all topsy-turvy, for we find the New South Wales Government spending in 1891 the extraordinary sum of £50,000 in bonuses for the destruction of 871 Emeus, over one million of marsupials, 65,000 hares and rabbits, 11,530 dingoes, 3,502 eagle hawks, and some other marauders. So in a short time the Australians will have to travel to foreign Zoological Parks to see what sort of a bird is this Emeu, about which their fathers talked so much."

THE CASSOWARY.

Cassowaries are interesting because of their adaptation to life in thick forest and dense undergrowth, rather than in the open. They are confined to New Guinea, the northern extremity of Australia and the small adjacent islands. The Cassowaries are smaller in size than the emeus, and, although structurally rather nearly related to these birds, yet in outward appearance Cassowaries have a number of characteristics peculiar to themselves.

Unlike the other birds of this Subclass, the bare skin of a Cassowary's head and neck is colored with brilliant pigments, and sometimes developed into one or more pendant wattles. The body feathers of old birds are black; half-grown birds are brown, and the young are striped.

The wings are small and weak, being mere flaps of skin, but they are furnished with five or six long, black quills, all that remain of the flight feathers which bore their ancestors through the air.

Cassowaries make their nests among the moss and leaves, where their eggs, which measure about three by six inches, are well protected by the green colour of their shells. They feed on various kinds of vegetable matter, and swallow large quantities of pebbles to assist in grinding up their food. These pebbles may be as large as hen's eggs. Little is known of the wild life of the Cassowaries, as their haunts are guarded by fierce tribes of cannibals. The few small islands on which they live are almost unexplored. About fourteen species are known, differing from each other in minor details of wattles, and in the coloring of the head and neck.

PAIR OF RHEAS.

These birds are good swimmers, and have been seen playing in the waves of the sea some distance from land. This may partly account for their distribution among so many small, adjacent islands.

THE RHEA.

The Rhea is the only member of the Ratite birds found in our hemisphere. It ranges over the open, treeless plains or pampas of South America, associating with herds of deer and guanacos, just as in Africa, ostriches seem to enjoy the company of zebras and antelopes. They feed on grasses, berries and seeds, but in captivity they are almost as omnivorous as the ostrich.

An interesting superficial parallelism exists between this bird and the ostrich, brought about entirely by life in similar environ-

OSTRICH CHICKS ON A CALIFORNIA OSTRICH-FARM.

By permission of Mr. Edwin Cawston.

ments. The hair-like plumage is of a light ashen colour, while the breast and thighs are white. The height of an adult bird is about five feet. The wing feathers are large, out-curved and fluffy white. Commercially these feathers are not as valuable as the plumes of the ostrich, yet many thousands of Rheas are killed annually, and as the young are not easily reared in captivity, it seems certain that the group will soon become extinct.

Several females unite in depositing their eggs, to a total number of twenty to sixty, in a single large depression in the soil. As with the other birds of this group, the male takes upon himself the entire labour of incubation and the rearing of the young birds. When fresh the eggs are golden-yellow in colour, but they soon fade to a dull whitish. When the male birds indulge in combats for supremacy over the females, they twine their necks together, and bite and kick quite savagely.

The Indians of the pampas hunt the Rhea on horseback, and capture it by means of the bolas—two leaden balls connected by a strip of rawhide, eight or ten feet in length. This is skillfully thrown from a distance of as much as fifty yards. The strand wraps about the neck and legs of the bird, hurling it helpless to the ground.

The general mien of the Rhea is stately, and its actions are easy and graceful. They are gentle birds in captivity, and are easily tamed, especially if they are captured when young. The Rhea will probably be the first of the four large ostrich-like birds to be exterminated by man, the emeu coming next.

THE OSTRICH.

The greatest of all living birds is the African Ostrich, a full-grown male standing eight feet and easily reaching to a height of nine feet. The maximum weight of such a bird is about three hundred pounds.

In the matter of vision, the Ostrich is the very antithesis of the apteryx, and its great height enables it to command an extensive view. On the other hand, in power of scent it is very deficient. These facts result in a reciprocal friendship between these birds and herds of zebras and antelopes. Should an enemy creep up through cover of clumps of grass, the keen nostrils of the four-footed creatures give timely warning; while in a more open country, when there is no wind, the eyes of the giant birds unerringly search out the distant foe.

The Ostrich was well known to the ancient Pharaohs of Egypt,

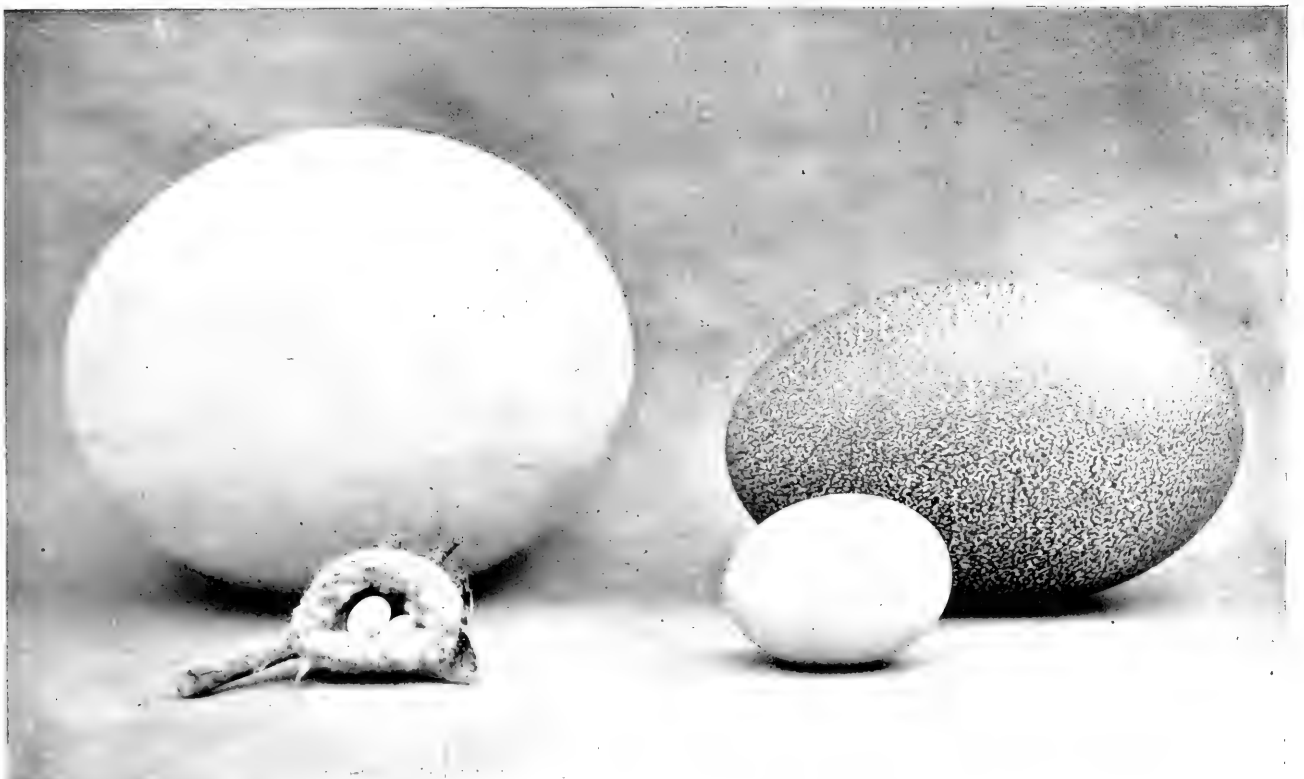
who used its feathers for ornament, and so struck were they with the evenness of the vane of the feathers that with it they crowned Thmei, the goddess of truth, making it the symbol of even-handed justice.

About this gigantic bird there has arisen, as a matter of course, many myths and fables in the folk-lore of various nations. Several of these are worth considering. The proverbial silliness of these birds has a foundation in the fact of their easily becoming confused when approached by several horsemen from different directions. The world-wide idea of their fondness for a diet of hardware, and their ability to digest metal, originated, doubtless, from their custom of swallowing large quantities of stones and other substances, to aid the gizzard in triturating their food—a habit shared on a smaller scale by our domestic fowls. Lastly, the fable of hiding their heads in the sand to avoid detection has some foundation in their habit of crouching as closely as possible to the ground, when they think they are observed; a great eight-foot creature thus transforming itself into an inconspicuous ant-hill, or mound of earth, as is shown in the photograph. Job has given us a number of facts concerning the life history of the Ostrich, but he fell into one or two errors.

The eggs of the Ostrich are round and white and about twenty times the size of a hen's egg. The white colour of the shells is a great protection in simulating the light sand in which they are laid.

During the breeding season the large flocks separate, several females being taken under the protection of one male bird. In some isolated part of the desert, a shallow basin is scraped in the sand, and all the hens lay their eggs in this simple nest. When about a dozen are deposited, the male begins to brood, sitting closely all night, surrounded by his females. During the day, the birds relieve one another, more to guard their treasure from jackals than to forward the process of hatching, for that is often left to the heat of the sun. The grey colour of the females is thus a protection to them when near the nest in the day, while the male, approaching only at night, needs no such protection, and has body feathers of jet black.

Ostriches show the greatest solicitude for their young. The male will sham a broken leg, or fiercely attack anything which threatens the safety of his family. The Ostrich is a bird of great strength, and very dangerous when angry, kicking out violently in all directions. Notwithstanding the great weight of a full-grown bird, already stated, the immense strength of its legs gives



EGGS OF THE OSTRICH, CASSOWARY, HEN, AND HUMMING BIRD.

it, in walking, an easy, mincing motion, suggestive of the great speed which it can attain when running.

Both the emeus and the Ostriches have a remarkable dance, which is sometimes practiced instinctively by mere chicks. It is a startling sight—yet one which can be seen almost every spring day in our Zoological Park—to see two of these great birds start at opposite ends of their corral and begin whirling round and round until they become almost a blur, the centrifugal force raising them upon their very toe-tips, like ballet dancers. Little by little they approach, wings whirring round, widely extended, when, suddenly they stop, facing each other, mouths open, reaching up eight or nine feet into the air.

Ostrich plumes are the only feathers which come to our millinery stores unstained by the murder of their owners. In Cape Colony, southern California, Arizona and other places, large ostrich farms have been established, and the annual product of ostrich plumes commands so high a price that these farms have proven quite profitable. The existence of the species will be prolonged by the fact that they breed readily in captivity. Even yet, many birds are killed for their feathers; but, roaming as some of them do, far into the African deserts, it is to be hoped that their total disappearance in a wild state may be long delayed.

It is stated that in 1862 the first attempt at ostrich-farming was made in the Cape Colony. Three years later only eighty tame birds were reported; but so great was the final success of the experiment that in 1875 it was estimated that there were 50,000 Ostriches in confinement in South Africa. Since that date the number has more than doubled. In 1875 the feather product was reported worth about $2,000,000, and from the years 1881 to 1883 the value of the "crop" was estimated at about $5,000,000 a year, from South Africa alone. In addition to the above, Egypt exports feathers annually to the amount of about $1,250,000; and the Barbary States about $100,000 worth.

A hen Ostrich will lay about ninety eggs in a year; and from these about sixty chicks will hatch, worth on emergence from the shell about twenty-five dollars apiece. At six months their value amounts to from seventy-five to a hundred dollars a bird. The eggs of captive birds are usually hatched in a large incubator, the time of incubation being about forty days. The chicks have none of the ungainliness of their parents, but are well-proportioned and are covered with a delicate speckled down.

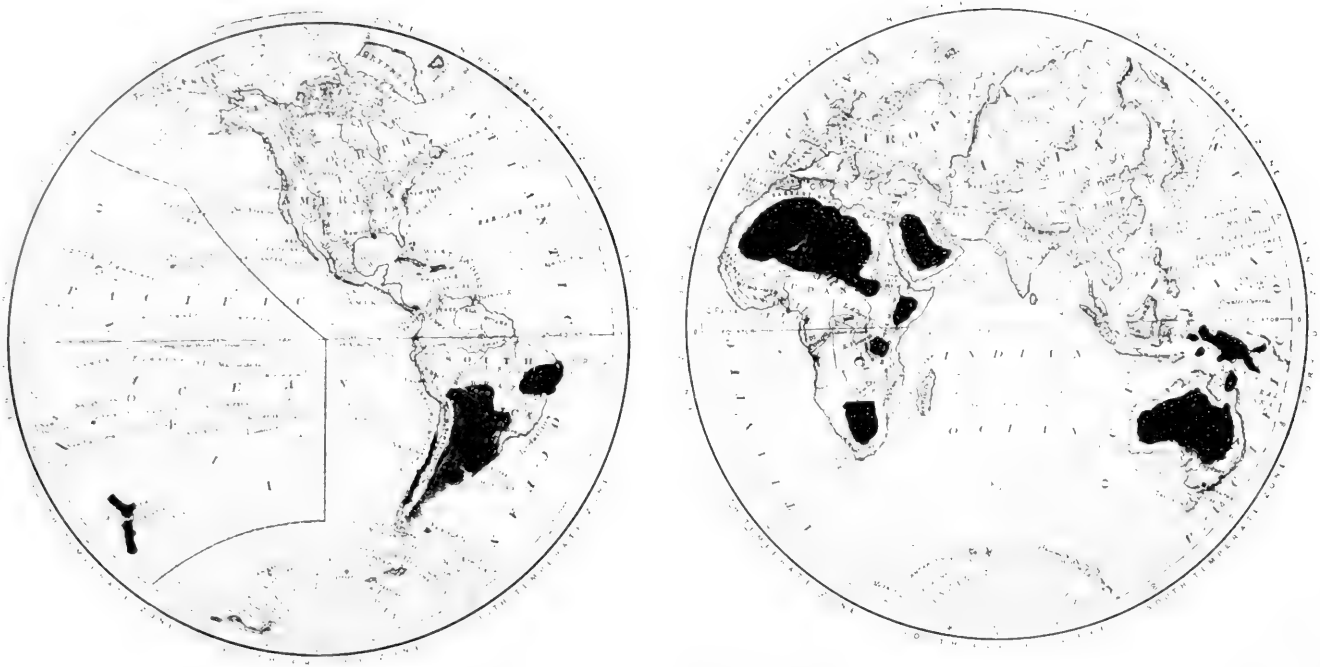
Let us hope that the ease with which these birds are reared in captivity may enable them to share the earth with us for many

OSTRICH LYING IN THE SAND.
From a photograph by C. W. Beebe.

years to come—the only lingering representatives of the giant birds which roamed the earth millions of years before the first human being began the ruthless work of extermination.

PART II.—EXTERNAL STRUCTURAL ADAPTATIONS TO CURSORIAL HABITS.

Functional radiation is developed to so remarkable a degree in the Class of Birds, that we find representatives of many orders which have become more or less specially adapted to a terrestrial, cursorial life. Examples of these are the Tinamous, almost all the members of the Order *Gallinae*, the Cranes, the secretary-bird among the Hawks, the road-runner among the Cuckoos, and the Larks among the Perching Birds. Yet in all of these birds, terrestrial locomotion is indulged in only as an alternative of the power of flight; and, except in the Tinamous, and to a less degree among the *Gallinae*, life on the ground has had no appreciable effect in lessening the wing power.



EASTERN AND WESTERN HEMISPHERES.

Showing the geographical distribution of the Ostriches and their allies.

The struthious birds stand alone in the extent of their fitness for a terrestrial, and a defensive-cursorial life; and this change in habits has brought about many interesting structural adaptations. There are some twenty-nine species and subspecies of *Ratite* birds, but the specific differences are of minor importance. In every case I have found it desirable to speak of *the* Ostrich, *the* Cassowary, *the* Emeu, etc., making the collective name stand for the group, and ignoring, in the present connection, all specific characteristics. I have confined myself entirely to the consideration of external adaptations—those which any visitor to the Zoological Park may observe for himself.

The characteristics peculiar to birds of the Subclass *Ratitae* may be divided into three classes:

1. Characters due to an early breaking away from the more typical avian stem. (These consequently are almost entirely reptilian.)

2. Characters which are *directly* due to a change from an arboreal, volant life to one wholly terrestrial and cursorial.

3. Characters which are *indirectly* due to this change in life habits.

In treating of the subject of this paper, I have not undertaken to divide the characters in this manner, but will briefly review them in anatomical sequence, as follows:

I. Integument.
   - A. Pterylosis (distribution of feathers in tracts).
   - B. Remiges (flight-feathers of wings).
   - C. Rectrices (rudder-feathers of tail).
   - D. Body Feathers.
   - E. Claws and Scales.

II. General Form.

I. INTEGUMENT.

A. Pterylosis.—Apteria mesogastraei.—This consists chiefly of the sternal callosity, or kneeling pad, of thick skin, on which these birds rest when lying prone upon the ground—the natural sleeping posture of Ostriches, Rheas, Emeus and Cassowaries. This habit, directly consequent upon their terrestrial life, would thus tend to keep this tract bare of feathers, even though elsewhere on the body the apteria inherited from volant ancestors should become all but obliterated.

Apteria trunci laterale.—This is represented principally by the naked under surface of the wings, a condition directly brought about by the disuse of those organs and their continual pressure

WING OF THE CASSOWARY.

WING OF THE OSTRICH

against the sides of the body. When this area is truncal in extension, or when small apteria are present in adjacent parts of the body, the condition is either wholly vestigial, or dependent on the action of the legs. This remarkable obliteration of apteria (which is paralleled only by the Penguins, and the horned screamer among the *Carinatae*) is, without doubt, only a secondary primitive character, although there is not that difference in the pterylosis of the embryo and the adult, which we might expect. The ventral apterium is fairly well developed in the adult Apteryx, which does not rest on its sternum and thus has no sternal callosity.

As special adaptations of degenerate feathers, are to be noted the well-developed eye-lashes of Ratite birds, especially in the case of the Ostrich. They may perhaps be necessary, even in addition to the nictitating membrane, in keeping the eyes clear of dust, which would be abundant in the deserts and plains of Africa.

The elongate, hair-like, facial feelers and rictal bristles of the Apteryx are, of course, metamorphosed feathers, and subserve the function of touch—most important in this nocturnal, vermivorous bird.

B. Remiges.—The remiges, as we might expect in structures whose sole original function has disappeared, have either diminished in number or run rampant. In one case only (the Cassowary) is there a suggestion of change of function, or adaptation to new conditions, although there is just a suspicion that the increase in number of the remiges of *Struthio* and *Rhea* may have some such significance.

It is evident that the ancestors of the Ostrich and the Rhea used their wings to a much later time than did the forebears of the Emeu, Cassowary and Apteryx. The only data for comparison which we have at present is the number of remiges in the Archaeopteryx, and the extreme variations which exist among the *Carinatae*. The following table will present the matter clearly:

	Primaries.	Secondaries.	Remiges.
Ostrich	16	20	36*
Rhea	12	16	28
Emeu	7	10	17
Apertyx	4	9	17
Cassowary	3	3	6
Archaeopteryx	6 or 7	10	16
Humming-bird	10	6	16
Albatross	10	30–40	40–50

*In one male bird which I examined there were no less than forty-one.

DEVELOPMENT OF THE OSTRICH FEATHER.

It is probable that early disuse of the wing as an organ of flight in the Cassowary, *consequent* on the restricted and forested condition of its habitat, led to a rapid reduction in the number of remiges. We now find only five or six stout, black, polished spines projecting from the edge of the wing. Exact homologies of these are to be found in the wing of the adult Apteryx. Here we find that the primaries possess a long, stout calamus, with the rhachis very distinct, but weakly developed. In the primary of a nestling Cassowary a correspondingly weak, scanty-vaned rhachis is formed, which ultimately breaks away at the umbilicus. Thus, in the adult Cassowary, the primaries are merely enlarged calami, which appear as hard, brittle spines. Their special use, if they have any, is yet to be discovered. The statement that they are of use in defense is absurd, both on account of their position and their weakness. The suggestion that they may aid the bird in extricating itself from a tangle of vines and undergrowth is very improbable, owing to the exceedingly weak musculature.

The large size and unusual number of the remiges in the wings of the Ostrich and Rhea may have resulted from their secondary use as aids in swift running against the wind, a kind of half-return of the lifting function of the wings of their ancestors. The less reasonable alternative hypothesis is, that the line of descent of *Struthio* was through some long-armed, multi-remiged race, with albatross-like wings. The Emeu and Apteryx, like the Cassowary, apparently began their return to a terrestrial life upon islands, or in more or less forested regions, where wings

COMPARISON OF THE FEATHERS OF THE OSTRICH, CONDOR, AND EMEU

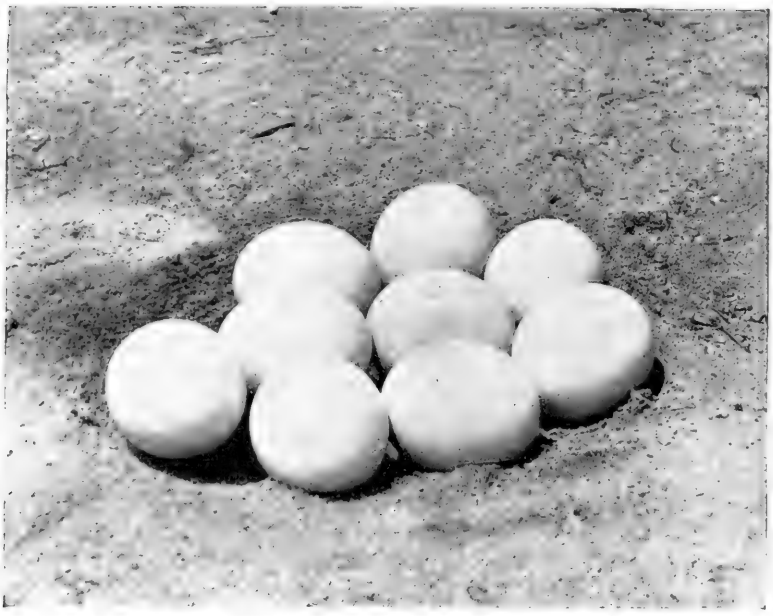
were not absolutely necessary. Hence the extreme degeneration of remiges in these birds.

The wide web of skin filling up the angle between the humerus and the body, in the wing of the Ostrich, is interesting as being perhaps a vestige of some old-fashioned patagium, functional in primitive ancestors.

C. Rectrices.—A rudder is as useless to a bird which has lost the power of flight as the fin of a tadpole would be to an adult frog. Thus rectrices are entirely lacking in the Rhea, Cassowary, Emeu and Apteryx. In the Ostrich, there are many long, loose-vaned, curling plumes representing these feathers.

D. Body Feathers.—These have followed three general types in their degeneration, or perhaps we should say that their present condition represents three more or less homologous stages. These are excellently represented in the photograph, and for comparison I have chosen a secondary from the wing of a condor.

As an example of the type showing least degeneration may be taken the feathers of the Ostrich and Rhea. In a typical feather



NEST AND EGGS OF THE OSTRICH.

of the former, the barbules will be seen to be very numerous, and on most of them vestiges of barbicels are easily distinguished. Thus an exact homology exists between an ostrich feather as a whole, and the proximal barbs of the condor's feather, brought about on the one hand by the loss of flight, and on the other by the overlapping of the adjacent wing coverts. This latter condition in the condor does away with the need for cohesiveness, which is such a necessity in the barbs of the more distal portion of the feather, where they are exposed to the impact of the air.

The body feathers of the Emeu and Cassowary are alike in being long and tapering, narrow-vaned and with an aftershaft, nearly as large as the rhachis of the main feather. A typical body feather of an Emeu presents several points of interest. A feather that is twelve inches in length has the proximal half of the barbs densely covered with soft, down-like barbules, which are destitute of barbicels. Throughout the distal half of the feather, barbules are absent and the barbs are broad, flat and horny. The texture of scales is redeveloped while yet the feather form is retained. This portion of the feather brings to mind the much divided leaflets of certain of the acacias. No reason has

NEST AND EGGS OF THE CASSOWARY

yet been assigned for the remarkable development of the aftershaft in the Emeu and Cassowary.

The third type of degeneracy is well shown by the body plumage of the adult Apteryx, in which the aftershaft is lacking.

To use an irrelevant simile, we can well realize that an athlete can run with much greater ease in his loose cotton "togs" than in a starched suit of clothing. Similarly the Ostriches and their allies can carry on their cursorial life to much better advantage in their loose, fluffy, hair-like plumage than in the less flexible feathers of their ancestors.

E. Claws and Scales.—Degenerate as are the wings of the ratite birds, all bear the indelible hall-mark of their reptilian prototypes. As in many *Carinatae*, all are furnished with one or more claws at the extremity of the fingers. In the Cassowary, Emeu and Apteryx the second finger alone is thus terminated, but in the Rhea there are two. In the Ostrich, not only are there large and perfect claws upon the first, or thumb, and the second finger, but even the third digit, although it does not penetrate the integument, bears a vestigial claw, this condition being

FEET OF THE OSTRICH.

thus homologous with that in Archaeopteryx. In an Ostrich, which I observed closely, and which was almost denuded of plumage, I again and again saw a curious and unexpected functioning of the large second claw. This bird would frequently flex the wing at the wrist and elbow, to an extent impossible in an ordinary bird of flight, and vigorously scratch its side, and even its neck. Ordinarily an Ostrich uses its toe in performing the latter action. It was most interesting to see such an unavian, quadrupedal act being performed by a bird.

All the toes of struthious birds are provided with claws—the four toes in the Apteryx, three in the Emeu and two in the Ostrich. Although almost every text-book of zoology assures us that the smaller toe of the latter bird is clawless, yet a claw is often present, reduced, however, to about the size of the claw on the foot of a common fowl. The short, thick, hoof-like character of the claw on the great middle toe of *Struthio* is an interesting parallelism to the hoof of the perissodactyl mammals.

An adaptation for defence is found in the claw of the inner toe of the Cassowary. The other claws are of normal size, but this one is very stout, sharp, and about four inches in length, a weapon with which the bird can do terrible execution upon an enemy at close quarters.

Little of adaptative interest attaches to the scalation of the leg. Although the entire hind limb of the Ostrich is bare of feathers, yet this can hardly be explained as due to the increase of function of that organ; for in one species of Rhea (*Rhea darwini*), the feathering is continued for some distance down, even on the tarso-metatarsus. The pink coloring of the bare skin and leg scales of some male Ostriches, differing in the different species, seems to partake of the nature of a secondary sexual character.

II. GENERAL FORM.

A terrestrial life has had two diverse effects upon the eyes of the ratite birds, throwing these organs into two very unequal classes; first, the eyes of the Apteryx, and second, those of other members of the Subclass, of which the Ostrich may stand as an example. Nocturnal habits, and a diet of earth-worms, as explained in Part I., have, in the Apteryx, resulted in the development of the olfactory and tactile senses at the expense of the optic power. In the Ostrich, on the contrary, the need for powerful vision in detecting enemies upon the open desert, while they are yet at a distance, has brought about a remarkably strong develop-

FEET OF THE RHEA.

FEET OF THE CASSOWARY.

ment of the eye. It, however, naturally lacks the delicate adjustment of the eyes of a bird such as a hawk, which can become near-sighted or far-sighted at will.

As in cursorial mammals, the general contour of the body of these birds is adapted to lessen resistance to the air. Yet in the present connection no stress can be laid upon this character, since the ratite birds are descended from true birds of flight, with keeled sternums and a general moulding of the body even more adapted for swift motion through the air.

FOOT OF THE APTERYX.

The enormous weight of some of the ratite birds is a condition impossible in a flying bird. A full-grown Ostrich may weigh three hundred pounds; while twenty-five pounds for a swan and thirty-two pounds for a bustard are maximum weights among the volant *Carinatae*.

Any extensive mention of the skeletal adaptations would be foreign to this paper, and indeed, when we study the bony framework of the struthious birds, we find so many characters which are dinosaurian and typically reptilian, that it seems as if any phylogenic comparison must be with the *Sauropsida* as a whole, rather than with Archaeopteryx or the *Carinatae* alone.

The most important changes in the skeleton, due to the cursorial habits of these birds, are plainly visible on the exterior. One feature is the long and flexible neck, correlated with the long legs. The swan is the only carinate bird which equals the Ostrich in the number of cervico-dorsal vertebrae, each having twenty-five.

The tall casque, or horny helmet, of the Cassowary, supported by osseus tissue within, is a special adaptation to protect the bird's head from the many hanging lianas and the undergrowth which it encounters when leaping and running at full speed through the dense forests of its haunts.

The flat, camel-like resting-pad of the Ostrich reveals the character which has given the name of *Ratite* to this Subclass of birds

—the flat, keelless sternum—all need of surface for the insertion of flight muscles having ceased long ago.

The increase in size and power of the legs is perhaps the most obvious adaptation of all. A two-fold function has resulted from this change from the more slender, ancestral hind limbs. The struthious birds have acquired the power to flee swiftly from danger, and in addition, when at bay, or in defence of their young, the massive development of leg and foot provides them with very formidable weapons of defence.

In Apteryx alone, in which the cursorial habit is perhaps least developed, there are four toes. Emeu, Cassowary and Rhea have three, while the Ostrich has but two. This latter bird shows an interesting parallelism with the mammalian genus *Equus*, in the development of one toe at the expense of the others. At college an athlete is told to run on his toes alone, and, instinctively, throughout all time, those creatures, which have had to run for their lives in life's great race, have followed this rule. The horse, the kangaroo and the Ostrich have never broken training, and all are tending toward the one-toed condition of the first-mentioned animal. In the kangaroo the fourth toe is the dominant one; in the other two animals it is the middle, or third toe, upon which all the stress comes.

The voice of the struthious birds is as primitive as many of their other characteristics, and, though they have traces of some kind of an ancestral syrinx, yet their utterances are in keeping with their massive frames—reverberating rumbles, booms and roars, which latter vocalization in the Ostrich so much resembles the roar of a lion that it may be somewhat of a protection against their natural foes.

Mr. J. G. Millais in his "Breath from the Veldt" says that the difference between the utterances of the two creatures is in power rather than in quality or sequence of sounds. He illustrates them in this way:

LION

(crescendo) (diminuendo)
Moan-ROAR - R-O-A-R-ROAR-Roar-roar-Grunt-grunt-grunt-grunt-grunt-grunt (dying away).

OSTRICH

(crescendo)
ROAR-ROAR-ROAR-ROAR-R-R-R-R-R (prolonged).

If we briefly review the various characters of the ratite birds we are as baffled in deciding which is the most specialized, as in studying the meagre fossil remains of this class. Although a bird of strong flight, Ichthyornis yet retained most primitive biconcave vertebrae. In like manner the two-toed, small-winged Ostrich is armed with two good claws on its fingers; and indeed we find in them all, a similar tangle of old and new characters, as puzzling as they are inspiring to further study.

TYPICAL MOUNTAIN GOAT COUNTRY

FIVE GOAT MAY BE SEEN IN THE CLEFTS OF THE ROCKS.

Photographed in northern British Columbia by the late E. A. Stanfield

THE ROCKY MOUNTAIN GOAT.

By MADISON GRANT.

THE white or Rocky Mountain goat shares with the musk-ox the honor of being the least known of the game animals of North America and descriptions of it written even as recently as ten years ago are valueless, as in many cases this animal is confused with white mountain sheep and even with deer. The explanation of this lack of knowledge lies in the extremely remote and inaccessible habitat of the goat, which begins in the northwestern United States, among the highest peaks of the Rocky Mountains and of the coast ranges and extends north, through British Columbia, into Alaska. The material in most natural histories, relating to this animal, is scanty and based on very inadequate information, since the opportunity to see and hunt it has not been granted to many. In captivity, we have had, on the Atlantic coast, only eight immature specimens, two in Boston in 1899, two in Philadelphia in 1893, and the four now (1905) living in the New York Zoological Park. One well grown male is living at this time in the London Zoological Garden.

As a result of this scarcity of direct knowledge, many myths have gathered around this mountain dweller, leading, as usual in our North American game animals, to an abundance of inappropriate names. The name "goat" is objectionable, but will have to stand until some better term can be found. The Stoney Indians in Alberta use the name "Waputehk," and in Chinook, the universal jargon of the Northwest, the goat is called Snow Mawitch (white deer). Neither of these terms are likely to become common. It is not a goat, nor even closely related to them, but is the sole representative on this continent, of a very aberrant group of so-called mountain antelopes, known to science as the *Rupicaprinæ*, a Subfamily of the *Bovidæ*.

THE MOUNTAIN ANTELOPES.

The *Rupicaprinæ* comprise five widely scattered genera, extending from the Pyrenees of Spain, to the Rocky Mountains of the western United States, as enumerated below.

GOAT COUNTRY ON THE SUMMIT OF THE MAIN ROCKIES

EAST OF THE MAIN ROCKIES, INDICATING CHARACTER OF COUNTRY WHERE GOAT, SHOWN ON PAGE 14, WAS SHOT.

In western Europe we find first the chamois (*Rupicapra*), known in the Spanish Sierras and Pyrenees as the izard, and extending eastward through the Alps and Carpathians as far as the Caucasus. Throughout all this range only one species is recognized.

The next genus of this group is the goral (*Cemas*), with four species ranging throughout the Himalayas and parts of China, into Amurland.

In Tibet we have the third and decidedly most aberrant member of the *Rupicaprinæ*, the takin (*Budorcas*), the horns of which suggest those of the gnu. Only one species of this genus is known.

The fourth, and to Americans perhaps the most interesting Old World member of this Subfamily, is the serow (*Næmorhedus*), locally known as the forest goat. This genus is perhaps, more closely allied to *Oreamnos* than any of the preceding genera, and its horns resemble those of the mountain goat, but are shorter and thicker. The genus *Næmorhedus* inhabits the Himalayas, Tibet and China with outlying representatives in Burma, Sumatra, Formosa and Japan and it is divided into numerous species. The fifth genus is *Oreamnos*, the subject of this article.

All the members of these genera resemble the goat in tooth structure, but differ widely from them in the position and shape of the horns, face glands and other important details. The whole group is to be regarded as an early off-shoot of the *Bovidæ*, to some extent intermediate between the goats and the true bovine antelopes. The *Rupicaprinæ* must have pushed north, with their not distant ally the musk-ox, at a very early time and become adjusted to alpine and boreal conditions. At the close of the glacial period many of its members deserted the low country and retired to high altitudes so that in some instances, notably that of the chamois, we have an example of discontinuous distribution. Its sole American representative probably reached this continent by way of the Bering Sea land connection, during the middle Pleistocene, together with the other American genera of the *Bovidæ*.

GENERIC CHARACTERS.

Oreamnos as remarked above, while more closely related to *Næmorhedus* than to the other members of the group, has departed widely in structure from all of its relatives. Its most

ROCKY MOUNTAIN GOAT

KILLED, AUGUST, 1902, BY ANDREW J. STONE IN THE SCHESLEY MOUNTAINS, BRITISH COLUMBIA.

Measurements of the animal, in detail, are given on page 35

HEAD OF THE GOAT SHOWN ON THE OPPOSITE PAGE.

striking character is its almost pure white coat. This coloring is in perfect harmony with an environment of snow fields, but in some parts of its range it renders the animal unnecessarily conspicuous. Until white men appeared on the scene, it made very little difference to the goat whether his enemies could see him or not, as his home was beyond the reach of pumas, wolves, and for the most part of bears and until other game became scarce, the Indians did not hunt this inaccessible peak-dweller too closely. All the types of *Oreamnos* are characterized by this white coat and the only exception is the well authenticated occurrence of goat in the Selkirks of southern British Columbia, with a clearly-defined dark brown line extending along the center of the back and terminating in an almost black tail. This color variation

appears to be fixed in both the summer and winter pelage, as the markings were found on the skins of goats killed both in July and November. Reports of goat with these characters are widespread along the upper Columbia River, so that it would seem as though toward the southern limit of its range, a color variation were just beginning to appear. In addition to its uniformly white color, *Oreamnos* differs from the serow in the prominence of its eye sockets, in the elongated shape of the muzzle and face, in the position and shape of the horns and more particularly in the cannon bones, which are exceptionally short and stout. In this latter respect *Oreamnos* departs widely from all the other members of the *Rupicaprinæ*. The most striking character however, of *Oreamnos,* is the presence, situated in a half circle immediately behind each horn, of a large, black scent-gland, as large as half an orange. This gland is sometimes so tough as to wear deeply into the base of the horn. A horn worn away in this manner was secured by the writer in British Columbia.

The comparatively short duration of time since the appearance of *Oreamnos* in America and the somewhat uniform character of its habitat, probably account for the absence of much type variation.

TYPES OF OREAMNOS.

The first specimens of the mountain goat to be described, came from the Cascade Mountains on the Columbia River in Oregon and of course now stand as the type of *Oreamnos montanus,* having been first described by Rafinesque in 1817. This subspecies is intermediate in size between the eastern form of American goat, *O.m.missoulæ*, and the large Canadian *O.m.columbianus*, and, is characterized by a short but broad skull. The true *Oreamnos montanus* extends from about the Canadian boundary, south through Washington into Oregon. In the '70's a considerable number were found on Mt. Ranier in Washington, and they still occur on Mt. Baker to the northward. It is absent, however, from the Olympic Mountains, from Vancouver Island and from the southern Cascades in Oregon. Nothing is known of the northern limits of this subspecies, but it probably does not extend very far into British Columbia, merging at that point into *O.m. columbianus*. The most southerly Oregon records that the writer has been able to obtain is Mt. Jefferson in that State, latitude 44° 40′ north, in approximately the same latitude as the Sawtooth Mountains in Idaho.

Probably the only place where the goat exists to-day in the State of Oregon is the mountains in Wallowa County, in the extreme northeast corner of the State, and the animals from that locality are probably to be referred to *O.m.missoulæ*. They have long since vanished from Mt. Hood and from the other peaks in the western part of the State, where they once abounded. In the State of Washington they exist in reduced numbers from the Canadian boundary as far south as Mt. Adams, although at the latter point they are possibly now extinct. Throughout the State the frequency of names, such as "goat rocks," "goat paths," "goat buttes" and "goat creeks," testify to their early abundance, and they were formerly shot from the decks of steamers on Lake Chelan by hunters who took a wanton delight in seeing the wounded animals fall down the precipitous banks.

In the Mt. Rainier Forest Reserve they are found in small numbers. In the isolated volcanic peaks along the coast the goat is too easily reached to be allowed to survive, and it is probable that before many years the interesting animal will be entirely exterminated in the United States except in the main Rockies.

The Alaskan form, at the extreme western limit of the genus, in the neighborhood of the Mt. St. Elias Alps and the Copper River, was described by Dr. D. G. Elliot, in 1900, as a second and valid species, under the name of *Oreamnos kennedyi*. It is strongly characterized by the lyrate shape of the horns and certain anatomical features.

These two were the only described forms, until 1904, when the attention of Dr. J. A. Allen, of the American Museum of Natural History, was called by the writer to the great difference in bulk of body and size of horns of the goat of British Columbia, and those of the Bitter Root Mountains in Montana. Upon comparing a number of specimens from the Cascade Mountains, the type locality of *Oreamnos montanus*, from the Bitter Root Mountains of Montana and Idaho, from the main Rockies in southern British Columbia and from the Schesley Mountains of northern British Columbia, it was found that all these specimens could be divided into three easily distinguishable groups each of subspecific rank.

The skulls of animals killed in the Schesley Mountains by Andrew J. Stone in 1903, were found to be in all respects identical with those killed by the writer and Mr. Charles Arthur Moore, Jr., in the main Rockies, near the Columbia River the following year. Animals from these districts were characterized by great bulk and by a long and relatively narrow skull.

ROCKY MOUNTAIN GOAT

ERLUC PS. PILLAMACHENE VALLEY, SOUTH OF GOLDEN, BRITISH COLUMBIA, NOVEMBER, 1903

[illegible] length with tail, following convolutions of body, 73 inches; tail, 7 inches; hind foot, 12 inches; [illegible] ilder, 41 inches; measurements taken after mounting. On exhibition in the American Museum of Natural History.

SIDE VIEW OF SPECIMEN SHOWN ON OPPOSITE PAGE.

This was the third type described and it received from Dr. Allen the name of *O.m.columbianus*. This subspecies probably extends from the American border up through the Canadian Rockies, to the northern limits of goat in that region, which is west of the Mackenzie River at about north latitude 63° 30′. The goat in the northern Rockies, may possibly be found to be specifically distinct from the goat on the coast of southern Alaska.

In the midst of the distributional area of this large subspecies and in the vicinity of the Big Bend of the Columbia River, a very small goat is found. This animal, upon further investigation, may prove interesting. At present, however, all the Canadian goats must be provisionally assigned to *O.m.columbianus*.

A curious break in the range of this subspecies is found just north of the Liard River, where, according to no less an author-

ity than Andrew J. Stone, no goat are found for a distance of over a hundred miles. Probably the local topography, of which we have no knowledge, will explain the absence of goat from this territory. No goat have yet been found north of the Yukon River.

O.m.columbianus abounds along the coast ranges of British Columbia, and extends into Alaska, probably merging in the neighborhood of the Copper River into *O. kennedyi,* the westernmost member of the genus. The extreme western record for goat is the Matanuska River, not far from the head of Cook Inlet. Horns from this locality, however, do not show the characteristics of Kennedy's goat. No goat are reported in the vicinity of Mt. McKinley, but they are found along the Copper River for a considerable distance inland, and there is some evidence of their occurrence on the north side of Mt. St. Elias. It may be well to remark here that while *O. kennedyi* is a valid species, founded on abundant material, no living specimens have been seen by a white man so far as is known, nor have we any information concerning the limits of its distribution. *O.m.columbianus* is by far the largest and handsomest member of the genus, unless *O. kennedyi* proves on further investigation, to excel in these respects. It is, therefore, surprising that the great differences in size and other characteristics, which distinguish this type from the goat in the United States have not been previously recognized.

The animals south of the Canadian border and still in the main range of the Rockies, upon comparison with the preceding types, were found to be much smaller, in fact the smallest of all the subspecies and were characterized by shorter but still relatively narrow skulls. The specimens of this type under consideration having been killed in the Bitter Root Mountains, the subspecific name of *O.m.missoulæ* was given them by Dr. Allen. This is the fourth and last type to be described, although these animals from the Bitter Root Mountains were the first goat known to transcontinental explorers. This is the goat usually hunted by American sportsmen and its range probably extends from the southeastern limits of the genus in Montana and Idaho to the Canadian border, where like *O. montanus* it passes imperceptibly into *O.m.columbianus.* The extreme southerly limit of the goat in the Rockies is the Sawtooth Mountains and the Salmon River in Idaho. It does not reach the Tetons, in Wyoming, nor does it occur in the Yellowstone Park. The question of its absence in these localities will be discussed later in this paper.

To sum up, the two American subspecies are smaller than their

WHITE MOUNTAIN GOAT AND MOUNTAIN SHEEP

IN THE NEW YORK ZOOLOGICAL PARK.

WHITE MOUNTAIN GOAT AND MOUNTAIN SHEEP

IN THE NEW YORK ZOOLOGICAL PARK

Canadian relatives and the type from the Cascade Mountains possesses a broad skull, in direct contrast to the narrow skulls of all other goats, both American and Canadian.

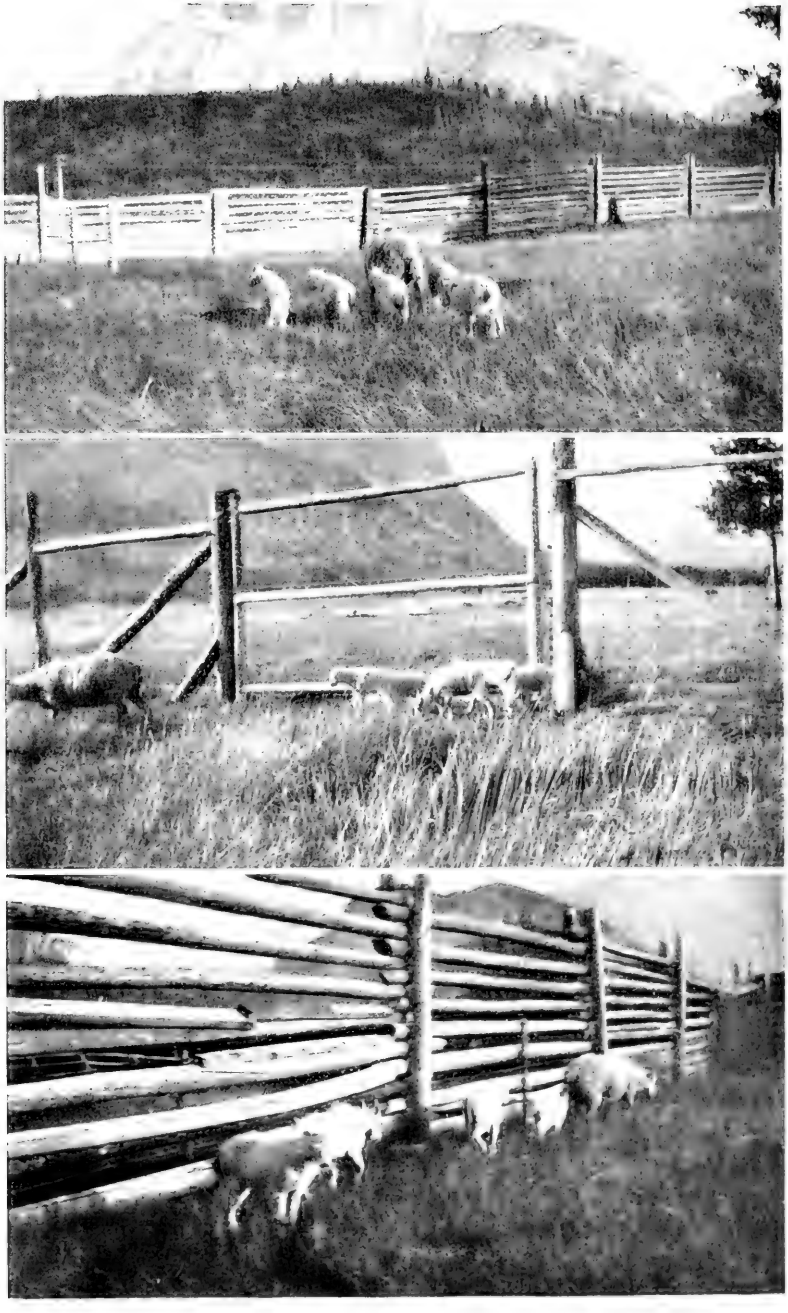
CAUSES GOVERNING DISTRIBUTION.

The distribution of the genus is limited by the character of the mountain ranges, rather than any other consideration, and too much emphasis cannot be placed on the fact, that of all our North American animals the white goat is the only one absolutely confined to precipitous peaks and ridges, which even the mountain sheep seldom approach.

The extreme north and south ranges of *Oreamnos* in the main Rockies present several problems of great interest. The southern limit is clearly marked by a change in the formation and ruggedness of the mountains themselves, which, together with climatic conditions, and the lack of water in summer on the mountain tops, are sufficient to account for the absence of these animals much south of their present limit. A very different condition prevails in the north. At the extreme northern limit which is about 63° 30′, the mountains begin to lose their height but are still of considerable size and quite rugged enough to provide a suitable home for *Oreamnos*. White sheep are found all through these mountains, up to the very coast of the Arctic Ocean and westward through the Romanzoff Mountains in northern Alaska. These sheep are certainly not better equipped to resist arctic cold than are the goat, so we must seek for some cause other than climatic or topographical conditions. There must be some unknown and unfavorable condition of food supply which prevents *Oreamnos* from reaching the extreme north. This is perhaps the most interesting and difficult of the problems affecting the distribution of the genus.

Along the Pacific coast of the United States the mountains are not sufficiently precipitous to attract the goat, and consequently that animal is found only at some distance inland, but in northwestern British Columbia and southern Alaska, the Rockies approach the coast in stupendous chains, which swing westward through the Mt. St. Elias range. Through all this country the goat occupies the coast region from Prince William Sound south nearly to the American border. They are not found in any of the adjacent islands.

Along these coast ranges goat are much more numerous than in the main Rockies, owing probably to the presence of forests



SEVEN MOUNTAIN GOAT KIDS

CAPTURED NEAR BANFF, ALBERTA, 1924, FOR THE NEW YORK ZOOLOGICAL SOCIETY.

high up in the mountains and in close contact with the cliffs where the goat lives, together with a copious supply of water. At all events the conditions are certainly favorable. North of Skagway goat do not extend inland much beyond the summit of the coast range, and do not again occur until the main Rockies are reached, hundreds of miles to the east. The goat in these eastern mountains are, in all likelihood, specifically distinct from the coast goat, as practically all the other mammals of these two distinct faunal areas are separate species.

LEGENDARY DISTRIBUTION.

The writer has carefully traced out the legends regarding the occurrence of goat in Colorado, Utah, and California. There are persistent stories about the existence of white goat in Colorado, which, when investigated seem to have their origin in some domestic goat which are known to have escaped from captivity. It is, however, a certainty that *Oreamnos* has not existed in Colorado since the arrival of the white man, and there is no proof of its previous existence there. This statement is made after a full examination of the evidence.

The purpose of this paper has been to gather and summarize the known facts about this interesting animal and it has been necessary to discard a large amount of data contained in the literature of the subject. Statements by certain writers regarding the existence of the goat in Wyoming, Colorado, California, and even New Mexico, are extremely misleading. It is positively known that no goat have ever existed on Mt. Shasta, although this mountain has been a favorite locality for stories about mountain goat and the mythical ibex. The origin of these fables is easily traced to the former existence on Mt. Shasta of mountain sheep, the horns and bones of which are still occasionally found there. The straight horns of the mountain sheep ewe are probably responsible for most of these legends. It is bad enough to suggest the occurrence of goat on Mt. Shasta, but it is utterly absurd to assert their existence on Mt. Whitney, 300 miles farther south, and it is still worse to include in the range of the goat New Mexico or the barren coast mountains of southern California.*

The above examples will suffice to show the loose manner in

*See "Sport and Life in Western America and British Columbia," by A. W. Bailli -Grohman, page 117, London, 1900, and "The Wilderness Hunter," page 130, by Theodore Roosevelt.

KID OF MOUNTAIN GOAT (STANDING) AND MOUNTAIN SHEEP OF SAME AGE

CAPTURED IN 1924, NEAR MICHEL, BRITISH COLUMBIA.

Now on exhibition in the New York Zoological Park.

which this subject has been treated by writers who have not sifted the evidence sufficiently.

Within the United States the mountain goat is only found in Idaho, western Montana, Washington, and Oregon. There is no evidence whatever of the white goat having existed in Wyoming. In examining the rumors respecting the occurrence of goat one must remember that only a few years ago very little was known about this animal, and few people had seen it. In the south, escaped domestic goat and old mountain sheep ewes with bleached coats and straight horns, have probably been the basis of many such stories. In some places such animals have been mistaken for white goat and elsewhere, notably in Alaska, for the legendary ibex. Until the discovery and description of Dall's white sheep, in 1884, all white animals in the north were called goat and white mountain sheep meat is sold to-day in Dawson City restaurants under that name.

There is no reason whatever to believe that the limits of the distribution of the white goat were ever much different from what they are now, except in outlying localities along their southern limits. The center of the greatest abundance of goat appears to be in the coast ranges in British Columbia and southern Alaska and it is here that they are found low down the mountain sides and often close to salt water.

COMPARISON WITH SHEEP.

It is due to ignorance of the character of the country inhabited by mountain goat that so much has been written about an alleged antipathy between *Oreamnos* and the mountain sheep. It is singular that writers should go so far afield as to conjure up an imaginary mutual hatred to account for the undoubted fact that sheep and goat seldom live together. In some places, however, notably the Schesley Mountains, sheep and goat can be found on the same mountain side. Sheep belong to the rugged hills and lower slopes and at one time ranged far eastward into the plains wherever the character of the country was at all rough, as in the Black Hills and in the Bad Lands of the upper Missouri.

The sheep is furthermore, a grass-eating animal, while the goat is a browser, finding his food mainly on the buds and twigs of the forests that grow to the very foot of the goat rocks. All through the goat country occur patches of forest and it is there that the goat is found, between timber-line and the snow fields. So far as we know the only grazing done by the goat, beyond

TWO GOAT KIDS AND MOUNTAIN SHEEP LAMB, BORN IN THE SPRING OF 1904

CAPTURED NEAR FORT STEELE, BRITISH COLUMBIA.

Now living and on exhibition in the New York Zoological Park.

nibbling at small plants, is on the slides when the grass first appears and it is probable that to this habit the greatest mortality of this animal is due, as many are killed each spring by the avalanches on these snow slides.

The sheep is an active, wary and fleet-footed animal, fully as well equipped as the deer to escape by agility from its enemies and is not dependent for safety on a refuge beyond the reach of other animals. The goat on the other hand, is heavy, powerful, clumsy, slow moving and somewhat stupid and does not dare to venture very far from its inaccessible rocks. It thrives among precipitous cliffs, which are everywhere known among hunters as "goat rocks" and are recognizable as such at a glance.

LOCAL DISTRIBUTION.

In a mountainous country it is perfectly easy to say where goat are to be found, if there are any in the neighborhood. They descend, of course, into the upper limits of the forests, but always keep near to cliffs to which they can retire when attacked. Salt-licks have been found in the hillsides, where great holes have been eaten out by these animals. The trails which lead to some of the licks in British Columbia are worn so deeply as to resemble buffalo trails. Goat pass through the forests and lower slopes of the mountains in moving from one locality to another, but this of course, is exceptional. They sometimes swim rivers and have been killed while crossing the Stickine River in British Columbia, a wide and rapid stream.

So complete is the protection the goat finds in broken rocks and precipices, that they are practically out of danger from any animal approaching from below, except bear, which frequently lie in wait for them and occasionally capture an unwary individual. The eagles take a very heavy toll from the young goat in the spring.

The difficulty of reaching the mountain tops is, of course, a protection against man, but the conspicuous color and the slow movements of the animal make it a comparatively easy victim when once reached by hard climbing.

WATER SUPPLY.

The question of water supply on the mountains inhabited by goat has a most important bearing on the distribution of the animal. In a large portion of the southern range of the goat, little

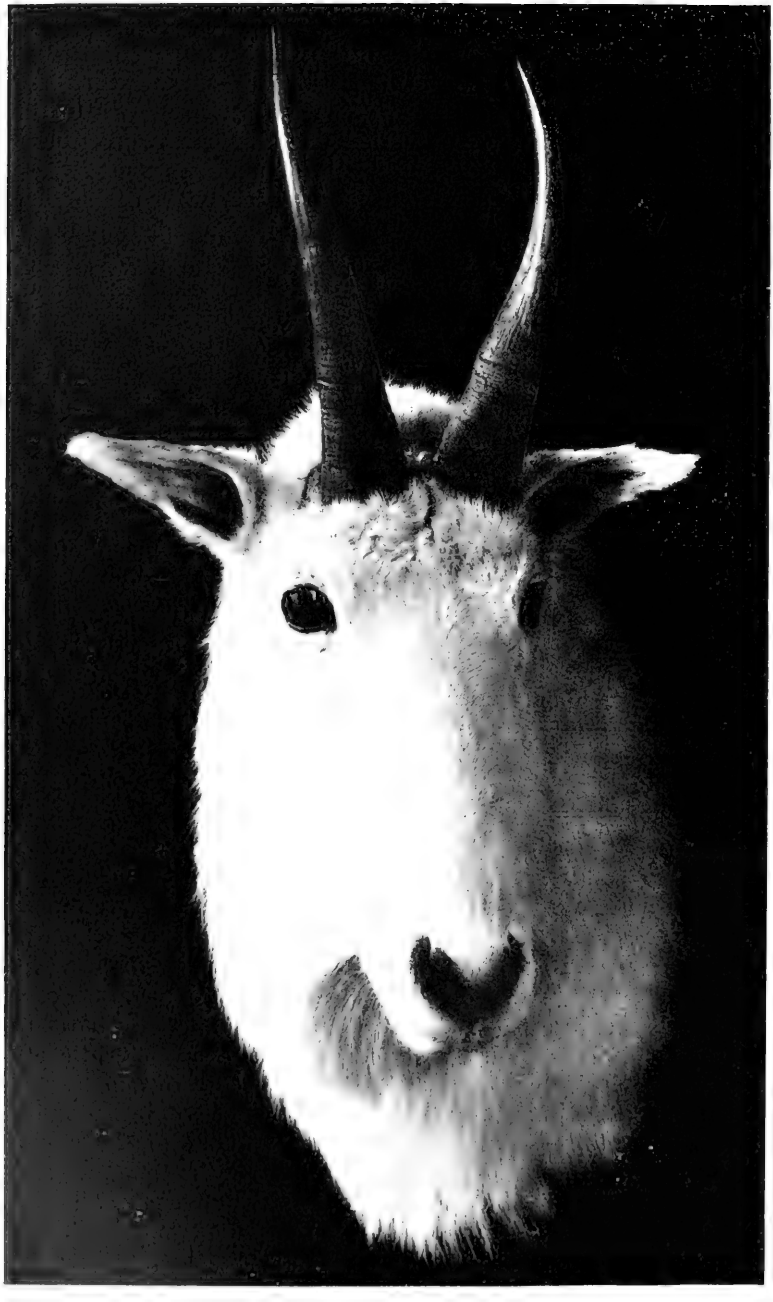
or no water is found from August to October, except what is furnished by such snow fields as persist throughout the year. All other animals can, during the dry season, venture down to the valleys and cañons for water, but the goat seldom leaves the rocks, even for water, relying on the snow of the mountain tops.

This fact alone, I believe, is sufficient to account for the absence of the goat, so often commented on by hunters, in many portions of its range, where other conditions appear to be entirely suitable. In southern British Columbia the great river valleys, such as those of the Kootenay, the Columbia and the Beaver, run almost north and south, and prevent communication from east to west between the goat inhabiting the adjacent mountains, while these same valleys offer no difficulties to the crossing of sheep and other large animals. Farther north in the Stickine country wide valleys are sometimes crossed.

The presence or absence of water on the higher ridges, taken together with the fact that the goat is not a very restless or migratory animal, accounts for many of the anomalies that are observed in its distribution. It is probable that in the course of its life the goat ranges over a smaller territory than any other of our game animals and unless seriously disturbed does not venture far from its native haunts as long as the food supply lasts. They can usually be found day after day on the same spot and goat have been watched, through glasses, which apparently scarcely moved for days at a time. Of course, in such a spot, food and water must be plentiful, and no danger threatening.

Along the Columbia River goat have been sometimes observed to get into positions on the face of the cliffs, from which they apparently could not escape. In spite of their great strength and climbing ability, their home must be an exceptionally dangerous one and it is probable that many lose their lives through accidents.

In British Columbia, during the early summer, the streams from the melting snow on the mountain tops are found in every draw and gulch. During this season small bands of females and kids, or solitary males, are scattered everywhere in favorable localities, from the upper timber to the summits of the mountains. As the season advances however and the snow-fed streams dry up, the only water available is found in the larger basins where the snow has accumulated in large quantities. These basins become the feeding ground of the goat and the rest of the mountain side is deserted, except for an occasional individual



MOUNTED HEAD OF GOAT SHOWN ON PAGE 54

the American Museum of Natural History

SIDE VIEW OF HEAD SHOWN ON THE OPPOSITE PAGE.

traveling along the summit from one such feeding ground to another, or during the autumn rutting season, when both sexes are almost constantly on the move. Connecting two favorite feeding grounds in the Palliser Rockies was found, in 1903, a

well beaten path along the summit-ridge, passing close to the snow fields and showing constant usage.

WINTER RANGES.

In winter the goat suffers from the severity of the storms on the mountain tops and the limit of its increase is, in the long run, dependent on the food supply available during this season. This is also true of most of our large animals and the elimination of the weak takes place during the terrible blizzards of winter and early spring.

In much of the southern range of the goat the use of the larger valleys for farming has undoubtedly interfered seriously with their lower feeding grounds. While the loss of these winter ranges is more serious for other game, even the goat feels the approach of civilization. The high valleys, however, still remain untouched and a certain number of hardy individuals will winter successfully in close proximity to settlements if not too much hunted. This is notably the case in the Bitter Root Valley, where goat are often found within sight of the town of Hamilton, Montana.

In winter the question of water supply is, of course, eliminated and at this season many ranges are well stocked with goat which, in summer, are deserted on account of lack of water. The goat travels so slowly that, aside from the danger of venturing far from the rocks, long daily journeys to and from a feeding ground are quite impossible.

As to food supply, we are apt to think of the mountain tops as barren in comparison with the valleys; but in a very mountainous region, such as British Columbia, the reverse is often true. On the higher mountain slopes and ridges are to be found the best pasturage and the most sunny resting places. The valleys receive the sun for a much shorter portion of the day than do the higher ridges and while the mountain tops are above the fogs, mists and clouds often darken the low country. It is noticeable that domestic cattle, sheep and horses in a mountainous country, are very partial to the high lands, seldom remaining voluntarily in the valleys and river bottoms. In such a country the first impulse of a grazing animal is to climb high. Anyone who has tried to hunt horses which have strayed from camp, is apt to be familiar with this habit.

It is the inaccessible character of the country inhabited by the goat and not his wariness or agility, which has made goat hunt-

ing a test of sportsmanship. Only those sound of wind and limb can venture after *Oreamnos*. The first rule in goat hunting is to go to the highest point that can be found and this point is apt to be very high.

HABITS.

The sight of a man does not seriously disturb a goat and it seems to be of indifferent power of vision. Sounds affect it even less. The constant falling of rocks and stones and the rumble and breaking up of the glaciers, close to which it finds its home, has led the goat to distrust the warning of its ears. Shouting at a goat only arouses a slight curiosity and the report of a rifle has scarcely more effect. The hunter may sometimes stand for an hour in plain view of a goat without disturbing it, but its sense of smell is highly developed and the slightest trace of human scent will alarm it.

These characters, together with confidence in the inaccessible nature of its habitat, born of long experience with animals other than man, have all combined to give the goat its reputation for stupidity. It probably is stupid, but less so than would appear to those accustomed to the nervousness of other game animals. The goat, like the skunk, has a serene reliance in its ability to protect itself and is accustomed to gaze with indifference at enemies who threaten it from below. The large males are not lacking in bravery and will savagely fight off a dog when attacked. Stories are told of wounded goat attacking man when cornered, but most of the danger to the hunter lies in missing a foothold, or in the stones rolled down from above by a fleeing animal.

Goat are marvelously tough and can carry more lead even than a grizzly. It sometimes seems almost impossible to kill them and in some cases when hopelessly wounded, they show a tendency to throw themselves from a cliff. That this is a deliberate act on their part is generally believed by goat hunters, but it is doubtful whether it is more than a last desperate effort to get out of harm's way.

Goat, like moose, are inclined to be solitary, but are often found in small family groups. They occasionally assemble in larger numbers in some favorite feeding ground, as many as twenty-seven having been seen together.

SKULL OF GOAT

KILLED BY MADISON GRANT, SEPTEMBER, 1903,

Main Rocky Mountains, east side of Columbia River, south of Golden, British Columbia. Measurements in inches: Right horn, 10½ inches; left, 10$\frac{3}{4}$ inches; spread of horns, 4$\frac{7}{8}$ inches. Both measurements are the largest on record, with a known history. Same specimen as on pages 26 and 27.

SIDE VIEW OF SKULL SHOWN ON THE OPPOSITE PAGE.

WEIGHT AND SIZE.

The strength of the goat is enormous and while its weight is far greater than one would at first suppose, it is a matter about which we have little definite information. An average specimen from the Cascade Mountains appears to weigh about 150 pounds. A six-year-old goat killed near Skagway, Alaska, showed an actual weight of 329 pounds. A much smaller animal killed at the same time and probably a female, weighed 250 pounds. Large goat from the main Rockies, in British Columbia and Schesley Mountains, have been estimated to weigh as high as 350 and 400 pounds. Mr. Baillie-Grohman publishes an account of a full grown male goat captured near Deerlodge, Montana, which was weighed after its capture and "was found to turn the scales at 480 pounds!" This, however, must be an error.

The size of the goat is emphasized by the long and shaggy coat, which at the shoulders rises in a hump. This, taken in connection with the low-carried head, gives the animal the appearance of a pigmy bison. Careful measurements of goat are hard to obtain, but authentic figures which were taken by Mr. Stone, of four goat killed in August, 1902, in the Schesley Mountains, British Columbia, are to be found at the end of this article.

HORNS.*

The horns of the female are slightly longer and much more slender than those of the male. A little over eleven inches appears to be the extreme limit of horns for the male. The longest horns known are from British Columbia, attaining a length of something over ten inches up to an extreme measurement of eleven and one-half, which appears to be the record. The horns from the Bitter Root Mountains average at least an inch shorter, as do those from the coast ranges in the United States. Any horn measuring over nine inches is to be considered of good size and anything over ten inches is very exceptional. All measurements of horns and antlers are subject to considerable variation, owing to the material of the tape and zeal of the man holding it and this must be taken into consideration in the measurements of record horns. In the measurement of the basal girth of sheep horns a variation of as much as an inch has been found to occur in the recorded size of the same horn taken by different persons, all quite conscientious in their efforts to be accurate.

* Measurements of horns are given at the end of this paper.

PROTECTION.

The mountain goat has probably a better chance of survival in a wild state than any other American game animal, except possibly the Virginia deer. It is protected even from man by the extreme ruggedness of its mountain habitat and although it will probably be exterminated in certain localities, if given a moderate amount of protection it can hold its own throughout most of its range. Its history will probably be like that of the chamois in Europe, as the country grows more populated.

In some localities it is in great need of protection. In southern British Columbia, the Indians, who are not amenable to the laws governing the white man, but are protected by treaty rights secured by the Dominion government, kill right and left with impunity. In Canada, even more than in the United States, solicitude for the noble red man works great injury to all our game animals. In the early days, from motives of self-interest, the Indian may have been moderate in his killing, but, having abandoned his archaic weapons in favor of modern fire-arms, he is now an unmitigated butcher.

The Kootenays on the upper Columbia and the Stoneys on the east face of the Rocky Mountains in Alberta, are game murderers and it is the boast of the latter that no game can live where they hunt. In the interest of game protection in British Columbia, it is greatly to be regretted that the enforcement of stringent laws cannot be extended to the Indians. Curiously enough, many persons, who would ordinarily be friendly to game protection, have become so interested in the natives, that they advocate hunting privileges for Indians which they deny to the white man, under the mistaken impression that the Indian kills only what he needs. The strange delusion has recently led to an attempt by a benevolent United States Senator to repeal the game laws for Alaska and leave that great game region to the mercy of the native and meat hunter.

SALE OF GAME HEADS.

The hunting of the Stoney Indians has been somewhat discouraged by a wise law recently enacted in the Northwest Provinces, prohibiting the sale of game heads. This law is especially beneficial to sheep, since the demand for heads of large rams has been steadily increasing. *Oreamnos* has not suffered greatly from head hunting, as its horns do not offer much of a trophy except

ROCKY MOUNTAIN GOAT AND SHEEP

IN THE NEW YORK ZOOLOGICAL PARK.

Born in the spring of 1904. Captured near Fort Steele and Michel, British Columbia

when needed to complete a collection of American game animals. The marketing of game heads cannot be too strongly condemned by genuine hunters and by those interested in the protection of wild animal life.

INTRODUCTION OF FOREIGN ANIMALS.

In this connection a word should be said about a proposition to establish chamois in the Rocky Mountains. Efforts to introduce European game, instead of protecting the native American animals, are constantly cropping out. Why anyone should prefer a chamois to the far finer native animal is somewhat of a mystery. Nature has provided for every portion of our country, mammals, birds and fish well adapted to the needs of the locality, and the introduction of foreign animals simply means, in case they survive, the crowding out of some native form.

In the East the mountain goat never can be more than an object of temporary curiosity, as he cannot long survive the rigors of our Atlantic summer. A number of young goat have been captured in British Columbia for exhibition in the New York Zoological Park, but while very docile, and taking readily to the milk of domestic ewes, they all died before shipment except the four now on exhibition at the Park. The proper place for the exhibition and breeding of mountain goat is in the Canadian National Park at Banff, Alberta, where there is an unsurpassed opportunity to secure and breed not only goat, but also mountain sheep, bison and even moose in their native environment.

ACKNOWLEDGMENTS.

The writer desires to acknowledge his indebtedness for assistance in the preparation of the above article to Mr. Charles Arthur Moore, Jr., to Mr. Andrew J. Stone, to Dr. J. A. Allen, to Mr. Charles H. Townsend, to Mr. Wilfrid H. Osgood, and to members of the Geological Survey, notably Mr. A. H. Sylvester.

MEASUREMENTS.

Four goat killed in the Schesley Mountains of British Columbia, in August, 1902, and measured with extreme accuracy, ran as follows:

	No. 43. inches	No. 44. inches	No. 57. inches	No. 60. inches
Total length, end of nose to end of tail vertebra	61	65	57	66
Tail vertebra	7 8		6	7½
Tarsus	13½	14	13	14½
Height at shoulder	40½	39	36	43

No. 57 was about a half-grown animal.

No. 60 was the largest specimen and its estimated weight was over 400 pounds.

Detail measurements in millimeters of No. 60* are as follows:

End of nose to lower corner of right eye	220
End of nose to base of ear	207
End of nose to base of right horn	265
Width of head just over eyes	147
Width of nose above nostril	65
Width of nostril	81
Greatest depth of head	193
Depth of nose	156
Depth of chin	119
Between the eyes	110
Circumference of horn at base	153
Length of horn	260
Width between point of horns	210
Length of ear	150
Width of ear	65
Length of beard	110
Length of front foot	83
Width of front foot	72
Extreme width of dew claws outside	80
Length of front of front hoof	52
Hind foot, length	71
Hind foot, width	72
Length of dew claw	52
Width of dew claws	34

* No. 60 is goat shown on page 10.

MEASUREMENTS OF MOUNTAIN GOAT HORNS IN INCHES.

Four large specimens in the United States National Museum, Washington, D. C., selected and measured by Madison Grant on February 4, 1905, gave the following dimensions:

	Right.	Left.	
♂	10	9¾	Lake Chelan, Washington.
♀	8½	8½	" "
♂	8⅝	8¼	Sawtooth Mountains, Idaho.
♀	7⅝	7¾	" "

Fifteen specimens in the American Museum of Natural History, New York City, were measured by Dr. J. A. Allen, with the following result:

		Right.	Left.	Spread.						
15752	—	7½	7½	4¾	*O. m. missoula*,			Missoula,	Montana.	
22694	♂	9	9 16	4⅞	"	"	"	"	"	
22695	♂	9¾	8⅝	4¼	"	"	"	"	"	
19335	♂	9	–	–	"	"	"	"	"	
19337	♀	9 13/16	9¾	4⅞	"	"	"	"	"	
19836	♂ jnr.	7 3/16	8¼	6½	"	"	*columbianus*,	Schesley	Mts.,	B. C.
19837	♂	–	9⅛	–	"	"	"	"	"	" "
19838	♂	9⅞	10	8⅛	"	"	"	"	"	" "
19839	♂	9⅛	8⅞	5	"	"	"	"	"	" "
19858	♀	8½	8½	5⅞	"	"	"	"	"	" "
21504	♀	9¾	9	4⅝	"	"	"	Main Rockies,		" "
21505	♀	9⅞	9⅞	5	"	"	"	"	"	" "
21506	—	7⅝	7⅜	4⅞	"	"	"	"	"	" "
Mt.										
*Head	♂	10⅛	10⅜	4⅞	"	"	"	"	"	" "
†Mt.	♂	9⅞	9⅝	6½	"	"	"	"	"	" "

* Head shown on page 26, property of Madison Grant.
† Property of Charles Arthur Moore, Jr.

BY-LAWS

OF THE

New York Zoological Society

AMENDED TO FEBRUARY 1, 1905.

ARTICLE I.

MEETINGS OF THE SOCIETY.

SECTION 1. The office and place of business of the New York Zoological Society shall be in the City of New York, unless otherwise ordered.

SEC. 2. The Society shall hold its annual meeting for the election of Managers, and other business, on the second Tuesday of January, or such day thereafter during the month of January to which said annual meeting shall adjourn.

SEC. 3. Special meetings of the Society shall be called by the Secretary, upon the request of the President or the Chairman of the Executive Committee, or at the written request of ten members.

SEC. 4. Notices of all meetings shall be mailed to each member of the Society at least three days before such meeting.

SEC. 5. At meetings of the Society twenty members shall constitute a quorum.

SEC. 6. The order of business shall be as follows:

1. Roll call.
2. Reading of minutes not previously read.
3. Report of Executive Committee.
4. Report of Secretary.
5. Report of Treasurer.
6. Report of Director of the Zoological Park.
7. Report of Director of the Aquarium.
8. Election of Managers.
9. Communications.
10. Miscellaneous business.
11. Reports and resolutions.

ARTICLE II.

BOARD OF MANAGERS.

SEC. 1. The Board of Managers shall consist of thirty-six members, together with the Mayor of New York and President of the Park Board, or Commissioner for the Bronx, who shall be members *ex-officio* of the Board.

SEC. 2. Nineteen Managers shall constitute a quorum, but ten managers may transact current business, and adjourn, subject to the subsequent approval of a meeting at which a quorum shall be present.

SEC. 3. The Board of Managers shall hold an annual meeting on the third Tuesday of January, or on such day thereafter to which said annual meeting shall adjourn. Regular meetings of the Board may also be called

by the Secretary on the third Tuesdays of October and April, upon the request of the President or Chairman of the Executive Committee. Special meetings of the Board shall be called at any time by the Secretary, upon the request of the President or Chairman of the Executive Committee, or at the written request of five Managers.

SEC. 4. Notices of meetings of the Board shall be mailed to each Manager at least three days before such meetings.

SEC. 5. The successors to the outgoing class of Managers shall be elected by the Society at its annual meeting, but vacancies in the Board may be filled for the unexpired term by the Board of Managers, or by the Executive Committee.

SEC. 6. A Nominating Committee shall be annually appointed by the Executive Committee, and shall consist of three members of the Society at large, who shall nominate and post ten days before the annual election the names of twelve persons to succeed the outgoing class of Managers in a conspicuous place in the office of the Society.

SEC. 7. No person shall be eligible for election to the Board of Managers, except to fill vacancies, unless his name shall have been posted as a candidate by such Committee, or by not less than ten members, in writing, in a conspicuous place in the office of the Society ten days before the annual election. All candidates for election as Managers must be Life Members, Patrons, Associate Founders, or Founders of the Society.

SEC. 8. Any Manager who shall fail to attend three consecutive meetings of the Board, unless excused by vote of the Board, shall cease to be a Manager.

SEC. 9. The Board of Managers shall at its annual meeting elect a President, two Vice-Presidents, a Secretary and a Treasurer, who shall hold office for one year, or until their successors are elected. The President, Vice-Presidents, and Treasurer shall be members of the Board.

SEC. 10. The Director of the Zoological Park, the Director of the Aquarium, and all other persons employed by the Society, shall be appointed by the Board or by the Executive Committee, and shall hold office during the pleasure of the Board.

SEC. 11. The Board shall, at its annual meeting, elect an Executive Committee and Auditing Committee, which shall hold office for one year, or until their successors are elected. The Board of Managers and the Executive Committee shall also have authority to appoint such other Committees or Officers as they may at any time deem desirable, and to delegate to them such powers as may be necessary.

SEC. 12. The order of business of the meetings of the Board shall be as follows:

1. Roll call.
2. Reading of minutes not previously read.
3. Report of Executive Committee.
4. Report of Secretary.
5. Report of Treasurer.
6. Report of Auditing Committee.
7. Report of Director of the Zoological Park.
8. Report of Director of the Aquarium.
9. Election of Officers.
10. Election of Committees.
11. Election of new members.
12. Communications.
13. Miscellaneous business.

SEC. 13. All reports and resolutions shall be in writing, and the ayes and nays may be called on any resolution at the request of one Manager.

SEC. 14. Whenever the funds of the Society shall permit, the Board of Managers or the Executive Committee may award medals or other prizes for meritorious work connected with the objects of the Society.

ARTICLE III.

OFFICERS.

SEC. 1. The officers of the Society shall consist of a President, two Vice-Presidents, a Treasurer, a Secretary and a Director of the Zoological Park. These officers, with the exception of the Director, shall be elected at the annual meeting of the Board of Managers, but any vacancy may be filled for an unexpired term by the Board of Managers, or by the Executive Committee, until the next annual election.

SEC. 2. The President shall preside at all meetings of the Board and of the Society, and shall be *ex-officio* a member of the Executive and Auditing Committees.

SEC. 3. The Vice-Presidents shall, in the absence of the President, perform his duties and possess his powers, acting in the order of their election.

SEC. 4. The Treasurer shall receive, collect and hold, subject to the order of the Board of Managers, or the Executive Committee, all dues, subscriptions, warrants from the City, fees and securities. He shall pay all bills as ordered by the Board of Managers or the Executive Committee, and shall report to the Society at its annual meeting, and to the Board of Managers at all regular meetings and to the Executive Committee at each meeting. He shall keep all moneys and securities in some bank or trust company to be approved by the Board of Managers or Executive Committee. The books of the Society shall at all times be open to the inspection of the Managers.

SEC. 5. The Secretary shall be a salaried officer of the Society. He shall be present, unless otherwise relieved by the Board or Executive Committee, at all meetings of the Society, of the Board and of the Standing Committees. He shall keep a careful record of all proceedings, shall have the custody of the seal, archives and books, other than books of account, and shall conduct the correspondence of the Society. He shall issue all notices and tickets and shall perform such other duties as the Board may direct. He shall be a member *ex-officio* of the Executive, Aquarium and Auditing Committees and of the Scientific Council.

SEC. 6. The Director of the Zoological Park shall be elected annually by the Executive Committee at a salary to be determined by said Committee, and paid monthly from funds of the Society. He shall be the responsible administrative officer of the Park, and shall recommend to the Executive Committee candidates for the various positions in the Park. He shall also perform all such other duties in connection with the business, scientific and literary administration of the Society as may be assigned to him by the Executive Committee.

SEC. 7. The Director of the Aquarium shall be elected annually by the Executive Committee, and shall hold office until removed or his successor is chosen by said Committee. He shall be the responsible administrative officer of the Aquarium, and shall recommend to the Executive Committee all candidates for positions in the Aquarium. The Director of the Aquarium shall be *ex-officio* a member and Chairman of the Aquarium Committee. He shall perform such other duties in connection with the Aquarium as may be assigned to him by the Executive Committee.

ARTICLE IV.

COMMITTEES.

SEC. 1. There shall be two standing committees, the Executive Committee and the Auditing Committee, which shall hold office for one year or until their successors are elected.

SEC. 2. The Executive Committee shall consist of seven Managers, together with the President and Secretary of the Society *ex-officio*. Four members shall constitute a quorum, and all meetings shall be called by the Chairman. The Executive Committee shall fill all vacancies in its own number and shall have the full powers of the Board of Managers, except so far as such delegation of power may be contrary to law.

SEC. 3. The Executive Committee shall have the control and regulation of the collections, library and all other property of the Society, and shall have power to purchase, sell and exchange specimens and books, to employ and control all officials and employees of the Society, Park, and Aquarium, and generally to carry out in detail the directions of the Board of Managers and the terms of any contract between the City, or Park Board, and the Society.

SEC. 4. All the rules and regulations for the examination of applicants for the various positions in the Park and Aquarium shall be made or approved by the Executive Committee.

SEC. 5. The Executive Committee may regulate the auditing and payment for all current accounts.

SEC. 6. The Executive Committee shall annually appoint an Aquarium Committee, whose duties and powers are set forth in Section 11 of Article IV. of these By-Laws.

SEC. 7. The Executive Committee shall annually appoint a Nominating Committee, whose duties and powers are set forth in Sections 6 and 7, Article II. of these By-Laws.

SEC. 8. It shall also appoint a Scientific Council, whose powers and duties are set forth in Section 2 of Article V. of these By-Laws.

SEC. 9. The Committee shall make a written report at each regular meeting of the Board of Managers.

SEC. 10. The Auditing Committee shall consist of three regular members of the Society, in addition to the President and Secretary, members *ex-officio*, and vacancies shall be filled by the Executive Committee. It shall be the duty of the Auditing Committee to audit, annually, the accounts of the Treasurer, of the Director of the Zoological Park, and of the Director of the Aquarium, and any other accounts of the Society, and shall report to the Board of Managers at its annual meeting.

SEC. 11. The Executive Committee shall annually appoint an Aquarium Committee not to exceed eight members of this Society, who shall hold office until their successors are chosen. All vacancies shall be filled by the Executive Committee. The Director of the Aquarium shall be *ex-officio* a member and the Chairman of the Aquarium Committee, and such Committee may vest in him any or all of its powers. The Chairman of the Executive Committee and the Secretary of the Society shall also be *ex-officio* members of the Aquarium Committee. Three members shall constitute a quorum. The Executive Committee may delegate to the Aquarium Committee such powers as it may deem proper.

ARTICLE V.

SCIENTIFIC COUNCIL.

SEC. 1. The Executive Committee shall annually appoint a Scientific Council of not more than ten members, and shall fill all vacancies. Members of the Council shall hold office until their successors are appointed.

SEC. 2. The duties of the Council shall be to act as an advisory board in all matters pertaining to the scientific administration of the Society, and especially as to the scientific features of the Park, the promotion of zoology by publications and otherwise, and the preservation of the native fauna of America.

SEC. 3. Four members, including the Chairman, shall constitute a

quorum. The Chairman shall be elected annually by the Council. The Chairman of the Executive Committee and the Secretary of the Society shall be members *ex-officio* of the Council.

ARTICLE VI.

MEMBERS.

SEC. 1. The present members and such others as shall become associated with them, under the conditions prescribed by the By-Laws, shall be members of this Society as long as they shall comply with the By-Laws.

SEC. 2. Members failing to comply with these By-Laws, or for other good and sufficient cause, may be expelled from the Society by the Executive Committee.

SEC. 3. Candidates for membership shall be proposed and seconded by members of the Society. The name, occupation and place of residence of every member so proposed shall be submitted for election to the Board of Managers or the Executive Committee, and such person, when elected, shall become a member upon payment of the annual dues, or of the fees as prescribed below.

SEC. 4. The annual dues shall be ten dollars, payable in advance, on the first day of May of each year, but the Executive Committee may remit the dues for the current year in the case of members elected between January 1st and May 1st of each year. The classes of membership shall be as follows:

SEC. 5. The payment of $200 at one time shall constitute any member a Life Member.

SEC. 6. The payment of $1,000 at one time, or in the case of a Life Member, of $800, shall constitute any member a Patron.

SEC. 7. The payment of $2,500 at one time, or in the case of a Patron of $1,500, or of a Life Member of $2,300, shall constitute any member an Associate Founder.

SEC. 8. Any member who shall donate to the Society $5,000, or property of equal value, or any Associate Founder who shall donate $2,500, or any Patron who shall donate $4,000, may be elected by the Board of Managers or Executive Committee a Founder.

SEC. 9. Any member who shall have donated to the Society ten thousand dollars ($10,000), or its equivalent, may be elected by the Board of Managers or the Executive Committee a Founder in Perpetuity. Such Founder in Perpetuity shall have the power to designate by a last will and testament his successor, who shall thereupon be entitled to all the rights and privileges of the original Founder in Perpetuity, including the right of designating in turn his successor.

SEC. 10. Any member who shall donate to the Society $25,000, or any Founder who shall donate $20,000, may be elected by the Board of Managers or Executive Committee a Benefactor. A Benefactor shall have all the rights and privileges of a Founder in Perpetuity.

SEC. 11. Persons who have rendered marked service in the science of zoology or natural history may be elected Honorary Members, but not more than three such Honorary Members shall be elected in any one calendar year.

SEC. 12. A resident member who shall have rendered marked scientific or professional services to the Society in any branch of its work may be elected by the Executive Committee a Life Member, Patron, Associate Founder, or Founder. A resident of New York who shall have rendered marked services in zoology or natural history may be elected by the Executive Committee a Permanent Fellow.

SEC. 13. Non-residents who communicate valuable information to the Society, or who have rendered marked service in the science of zoology or natural history, may be elected Corresponding Members.

SEC. 14. Benefactors, Founders in Perpetuity, Founders, Associate Founders, Patrons, Life Members, Honorary Members, Permanent Fellows and Corresponding Members shall be exempt from annual due.

ARTICLE VII.

PRIVILEGES OF MEMBERS.

SEC. 1. A member's ticket admits the member and his immediate family to the Park on reserve days, and to all lectures and special exhibitions, and may be used by the member's immediate family, and shall be good for the current year.

SEC. 2. Admission tickets to the Park and Aquarium on reserve days are issued to members for distribution, and are good for the current year.

SEC. 3. Each member of the Society is entitled annually to a member's ticket and to ten admission tickets.

SEC. 4. Each member shall also receive one copy of the catalogue or handbook, the report and official publications of the Society, and shall have all the privileges of the Library and Members' Building.

SEC. 5. No member shall be entitled to the privileges enumerated in this Article unless his annual dues shall have been paid.

SEC. 6. The Life Members shall have all the privileges of Members and ten additional admission tickets.

SEC. 7. Benefactors, Founders in Perpetuity, Founders, Associate Founders and Patrons shall have all the privileges of Life Members, and shall in addition receive copies of all scientific works published by the Society.

SEC. 8. Any member who shall fail to pay his annual dues within three months after the same shall have become due, and after notice of thirty days, by mail, shall cease to be a member of the Society; subject, however, to reinstatement by the Board of Managers or Executive Committee for good cause shown.

SEC. 9. Any person elected to membership who shall fail to qualify within three months after notice of his election shall be considered to have declined his election; but such term may be extended by the Board of Managers or Executive Committee.

ARTICLE VIII.

FINANCES.

SEC. 1. The fiscal year of the corporation shall be the calendar year commencing January 1st and ending December 31st.

SEC. 2. Neither the Society nor any of its Managers or Officers shall contract any debt which, with existing debts, shall exceed in amount the funds then in the Treasury, except to meet expenditures for which the city is liable, and for which the Society will be reimbursed by warrants from the Comptroller's office.

ARTICLE IX.

AMENDMENTS.

SEC. 1. Amendments to these By-Laws may be proposed, in writing, at any meeting of the Board of Managers, and adopted by unanimous consent of the Managers present, or if such proposed amendment shall fail to receive unanimous consent, the Secretary shall, with the notices of the next meeting, send a copy of it to each Manager and state that it will be brought up for action at such meeting, when it may be passed by a majority vote.

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